DELUXE
ANTENNA TUNER
Model SA-2060A

595-2871-05

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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Heathkit®

INTRODUCTION

Your Deluxe Antenna Tuner Model SA-2060A has all of the features of the popular Heathkit Model SA-2040 Antenna Tuner combined with most all the features of the Heathkit Model HM-2140 Dual Wattmeter. In addition, it includes the 160-Meter and WARC (30-, 17-, and 12-meter) amateur bands.

The Tuner is designed to operate on the 160 through 10-Meter amateur bands, and will effectively tune and match balanced or unbalanced feed lines, and single-wire and ladder lines at the full legal power limit of your station. With its continuously-variable inductor, you are assured precise antenna-matching all the way from 1.8 to 30 MHz, including the MARS frequencies, and all the newly-allocated bands. A convenient front panel counter enables you to quickly set the inductor to previously calibrated frequencies.

The silver-plated straps and roller contact assembly minimize RF loss at high frequencies. The large feedthrough insulators withstand high-voltage RF.

The dual wattmeter feature enables you to read both forward and reflected average power, in two ranges, up to the full legal limit of your station.

The wattmeter section of your Deluxe Antenna Tuner installs directly into your transmission line to measure the power on all frequencies between 1.8 and 30 MHz. It measures 200/2000 watts in the forward direction and up to 50/500 watts reflected. Dual meters indicate the forward and reflected power separately with ±5% accuracy for precise measurements. A factory aligned and calibrated sensor head insures this accuracy. SWR indications on the reflected meter provide direct readings from 1:1 to 3:1.

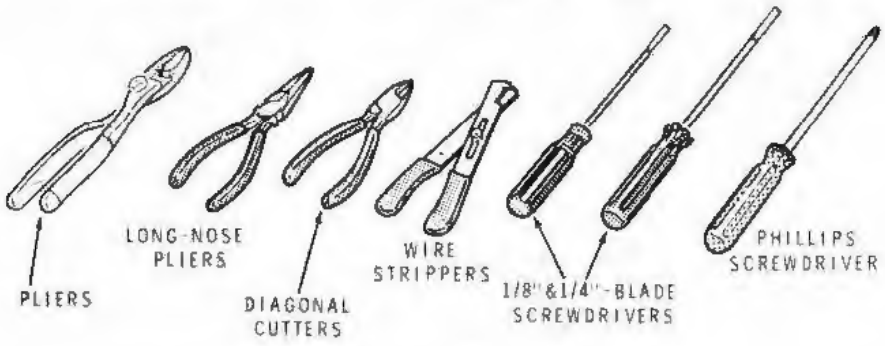
With a single switch you may select a dummy load, or any of three permanently-connected antennas, including a long-wire antenna. You no longer need to connect and disconnect feed lines to load your transmitter into the dummy load.

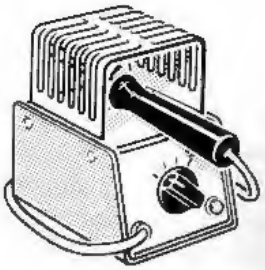
With its factory-calibrated components, easy-to-read dual watt-meters, and with all its controls on the front panel, your new Deluxe Antenna Tuner will soon become an integral, indispensible component of your system.

ASSEMBLY NOTES

TOOLS

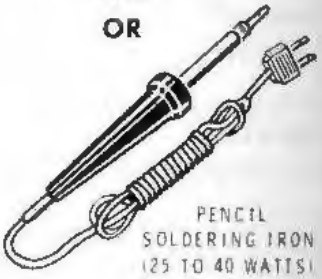
You will need these tools to assemble your kit.



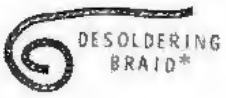


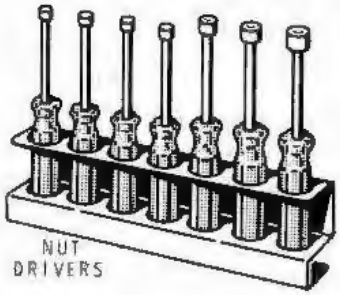
SOLDERING IRON

OR



OTHER HELPFUL TOOLS





*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In the Schematic,

   — In the section at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

It is easy to make a good solder connection if you follow a few simple rules:

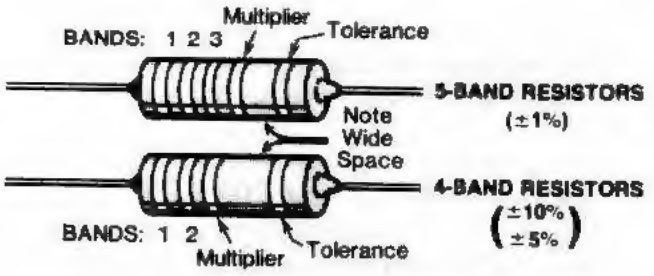
1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 or 50:50 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

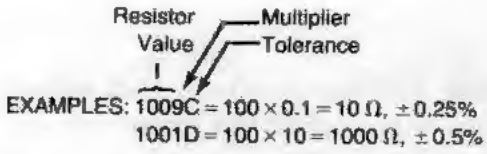
RESISTORS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). They are usually identified by a color code of four or five color bands, where each color represents a number. See the "Resistor Color Code" chart. These colors are given in the steps in their proper order (except for the last band, which indicates a resistor's "tolerance"; see the "Resistor Tolerance Chart"). You do not need to memorize the color codes.



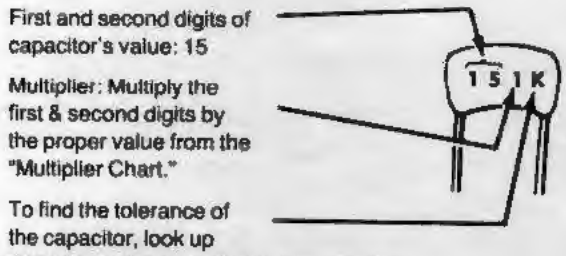
Occasionally, a "precision" or "power" resistor may have the value stamped on it. The letter R, K, or M may also be used at times to signify a decimal point, as in: 2R2 = 2.2 Ω
2K2 = 2.2 kΩ, or 2200 Ω
2M2 = 2.2 MΩ

Precision resistors may also be marked as shown in the following examples. The values of the multipliers are shown in the "Multiplier Chart," and the tolerance values are shown in the "Resistor Tolerance" chart.



CAPACITORS

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar®, electrolytic, etc. Some capacitors may have their value printed in the following manner:



RESISTOR COLOR CODE CHART

	Band 1	Band 2	Band 3 (if used)	Multiplier
Color	1st Digit	2nd Digit	3rd Digit	
Black	0	0	0	1
Brown	1	1	1	10
Red	2	2	2	100
Orange	3	3	3	1,000
Yellow	4	4	4	10,000
Green	5	5	5	100,000
Blue	6	6	6	1,000,000
Violet	7	7	7	10,000,000
Gray	8	8	8	100,000,000
White	9	9	9	—
Silver	—	—	—	.01
Gold	—	—	—	.1

RESISTOR TOLERANCE CHART

	COLOR OR LETTER	
±10%	SILVER	
± 5%	GOLD	J
± 2%	RED	G
± 1%	BROWN	F
±0.5%	GREEN	D
±0.25%	BLUE	C
±0.1%	VIOLET	B
±0.05%	GRAY	

MULTIPLIER CHART

FOR THE NUMBER:	MULTIPLY BY:	FOR THE NUMBER:	MULTIPLY BY:
0	1	4	10,000
1	10	5	100,000
2	100	8	0.01
3	1000	9	0.1

CAPACITOR TOLERANCE CHART

LETTER	10 pF OR LESS	OVER 10 pF
B	±0.1 pF	
C	±0.25 pF	
D	±0.5 pF	
F	±1.0 pF	±1%
G	±2.0 pF	±2%
H		±3%
J		±5%
K		±10%
M		±20%

EXAMPLES: 151K = 15 × 10 = 150 pF
759 = 75 × 0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point, as in: 2R2 = 2.2 (pF or μF).

PARTS LIST

Unpack the kit and check each part against the following list. Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until all the parts are accounted for.

The key numbers correspond to the numbers on the "Parts Pictorial" in the separate "Illustration Booklet" beginning on Page 1.

To order a replacement part: Always include the PART NUMBER. Use the Parts Order Form furnished with the kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual. Your Warranty is located inside the front cover.

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4 or HDW #6, etc.). You may have to open more than one packet to locate all of the hardware of one size (#6, for example).

#2 and #4 Hardware

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
A1	250-352	2	2-56 × 11/16" screw
A2	250-156	3	4-40 × 1/8" setscrew
A3	250-213	2	4-40 × 5/16" screw
A4	252-51	2	2-56 nut
A5	254-26	2	#2 lockwasher
A6	254-9	2	#4 lockwasher
A7	259-9	1	#4 solder lug

#6 Hardware

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
B1	250-1282	2	6-32 × 1/8" setscrew
B2	250-230	14	6-32 × 3/16" setscrew
B3	250-1280	18	6-32 × 3/8" black screw
B4	250-1423	6	6-32 × 3/8" flat head screw
B5	250-475	4	#6 × 3/8" hex head, sheet metal screw
B6	250-1264	2	6-32 × 3/8" hex head screw
B7	250-1331	4	6-32 × 5/8" screw
B8	250-134	1	6-32 × 3/4" brass screw
B9	250-79	2	6-32 × 1-1/4" screw
B10	250-1290	1	6-32 × 2" brass screw
B11	252-3	22	6-32 nut
B12	253-127	2	#6 flat steel washer
B13	253-714	28	#6 brass washer
B14	254-1	24	#6 lockwasher

#8 Hardware

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
C1	250-585	16	8-32 × 1/2" screw
C2	250-329	17	8-32 × 5/8" screw
C3	252-4	1	8-32 nut
C4	252-180	1	8-32 wing nut
C5	253-9	10	#8 flat steel washer
C6	253-715	48	#8 flat fiber washer
C7	254-2	8	#8 lockwasher
C8	259-2	2	#8 solder lug

#10 Hardware

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
D1	252-163	3	10-32 wing nut
D2	252-199	26	10-32 brass nut
D3	253-19	6	#10 flat steel washer
D4	253-716	16	#10 flat fiber washer
D5	254-3	3	#10 lockwasher
D6	259-26	3	#10 solder lug

Other Hardware

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
E1	250-1235	2	1/4-32 × 1/4" setscrew
E2	252-39	2	1/4-32 nut
E3	252-701	11	Control nut
E4	253-10	5	Control flat washer
E5	253-36	1	Brass spring washer
E6	253-749	6	Small cork washer
E7	253-750	6	Large cork washer
E8	254-5	5	Control lockwasher
E9	258-704	2	Dished spring
E10	258-705	2	Forked spring
E11	258-734	2	Contactor spring
E12	259-10	1	Control solder lug
E13	455-13	3	Short shaft bushing
E14	455-26	2	Long shaft bushing
E15	455-642	1	Shaft collar

KEY No.	HEATH Part No.	QTY	DESCRIPTION	CIRCUIT Comp. No.
SPACERS				
F1	255-3	2	3/8" spacer	
F2	255-58	4	Tapered spacer	
F3	255-719	50	Large 17/64" spacer	
F4	255-720	4	Large 3/16" spacer	
F5	255-721	100	Small 17/64" spacer	
F6	255-722	4	Small 3/16" spacer	
F7	255-726	8	8-32 x 8-5/16" spacer	
SHAFTS-COUPLERS				
G1	266-936	4	10-32 x 9-7/8" threaded brass rod	
G2	266-1047	1	Tension rod	
G3	453-266	1	2-3/4" metal extension shaft	
G4	453-277	2	2-3/8" fiberglass extension shaft	
G5	453-278	2	9-7/8" hex shaft	
G6	453-324	1	12-1/2" fiber shaft	
G7	456-7	4	Shaft coupler	
G8	456-44	1	Stepped coupler	
METAL PARTS				
H1	90-1257-2	1	Cabinet top	
H2	200-1430-1	1	Chassis	
H3	204-2207	6	Capacitor mounting bracket	
H4	204-2509	4	Meter bracket	
H5	204-2515	1	Counter bracket	
H6	204-1670	3	Capacitor front plate	
H7	205-1680	2	Capacitor rear plate	
H8	205-2048	50	Stator plate	
H9	205-2041	52	Rotor plate	
H10	205-1727	1	Shorting bar	
H11	206-406	1	Spiral shield	
H12	207-8	3	Cable clamp	
H13	212-57	1	4-1/4" strap	
H14	212-58	3	4-19/32" strap	
H15	212-60	1	6" strap	
H16	212-64	1	7-13/16" strap	
ELECTRONIC PARTS				
J1	6-1682-12	1	16.5 kΩ (brn-blu-grn-red), 1/4-watt precision resistor	R2
J1	6-4022-12	1	40.2 kΩ (yel-blk-red-red) 1/4-watt precision resistor	R1
J2	21-140	2	.001 µF ceramic capacitor	C8, C9
J2	21-176	4	.01 µF ceramic capacitor	C3, C4, C5, C6

KEY No.	HEATH Part No.	QTY	DESCRIPTION	CIRCUIT Comp. No.
Electronic Parts (Cont'd.)				
J3	10-14	1	250 kΩ control	R3
J4	40-2030	1	Roller inductor	L1
J5	64-884	1	Pushbutton switch assembly	SW1, SW2, SW3
J6	100-1836	1	Sensor assembly*	
J7	407-757	1	FWD meter	M2
J7	407-758	1	REF meter	M1
MISCELLANEOUS				
K1	71-2	3	Small ceramic feedthrough insulator (disassembled)	
K2	71-11	3	Large ceramic feedthrough insulator (disassembled)	
K3	73-43	1	3/8" grommet	
	76-147	1	3" foam tape	
	74-31	1	Glass-cloth tape (roll)	
K4	205-1741	2	Inductor end plate	
K5	261-9	4	Round foot	
K6	266-894	8	Ceramic insulator plate (1 extra)	
K7	266-898	2	Steel ball	
K8	266-1048	1	Roller contact	
K9	266-1213	1	Switch detent	
	344-147	11'	Teflon** insulated wire	
	347-55	8'	8-conductor cable	
K10	352-14	1	Grease pot	
K11	431-62	1	Terminal strip	
K12	446-723	1	Window	
K13	451-61	2	Nylon gear	
K14	462-1130	2	Small knob	
K15	462-1156	3	Large knob	
K16	465-6	1	Counter	
K17	475-19	2	Toroidal core	
K18	490-5	1	Nut starter	
K19	490-14	1	Large allen wrench	
K20	490-23	1	Small allen wrench	
K21	490-169	1	Open end wrench	
			Solder	
PRINTED MATERIAL				
L1	290-147	1	"Danger" label	
L2	390-2542	1	Front panel label	
L3		1	Blue and white label	
	597-280*	1	Parts Order Form	
		1	Assembly Manual (see title page for part number.)	

*See separate "Servo Assembly (#100-1836)"

**Registered Trademark, DuPont Corp.

Sensor Assembly (#100-1836)

IMPORTANT: The Sensor Assembly contains the following parts. This Assembly has been factory tested and aligned. **Do NOT attempt to adjust any components in the Sensor Assembly;** to do so may void the Warranty. Replacing components inside the Assembly may also cause it to require realignment at the factory.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS, 1/4-WATT, 5%			
6-470-12	2	47 Ω (yel-vio-blk)	R101, R102
6-332-12	1	3300 (org-org-red)	R103
6-223-12	1	22 kΩ (red-red-org)	R102
6-104-12	1	100 kΩ (brn-blk-yel)	R109
6-222-12	1	2200 Ω (red-red-red)	R101
6-472-12	1	4700 Ω (yel-vio-red)	R104
CONTROLS			
10-312	1	10 kΩ	R104
10-390	1	20 kΩ	R107
10-941	2	100 kΩ	R105, R106
CAPACITORS — COIL			
20-103	2	150 pF mica capacitor	C101, C102
20-172	2	.001 µF mica capacitor	C103, C104
31-8	1	1-8 pF trimmer capacitor	C105
40-1970	1	29.5 µH toroid coil	L101
HARDWARE			
250-480	2	4-40 x 15/16" screw	
252-19	2	4-40 nut	

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Hardware (Cont'd.)			
254-9	2	#4 lockwasher	
253-43	2	#5 flat washer	
250-1325	2	6-32 x 1/4" pan phillips head screw	
353-14	1	#8 fiber washer	
254-1	6	#6 lockwasher	
255-828	2	Spacer	
257-12	1	Eyelet	
259-6	2	#6 solder lug	
MISCELLANEOUS			
56-20	2	1N295A or 1N2955 or 1N60H inbolt diode	D101, D102
63-1400	1	Rotary switch	SW101
85-2038-1	1	Printed circuit board	
204-9	2	Angle bracket	
212-51	3	Switch bus	
214-230-1	1	Sensor housing	
340-3	4-1/2"	16-gauge bare wire	
340-8	4"	22-gauge bare wire	
346-21	1"	Sleeving	
347-39	3'	5-conductor cable	
438-56	4	Coaxial jack	J1, J2, J6, J7

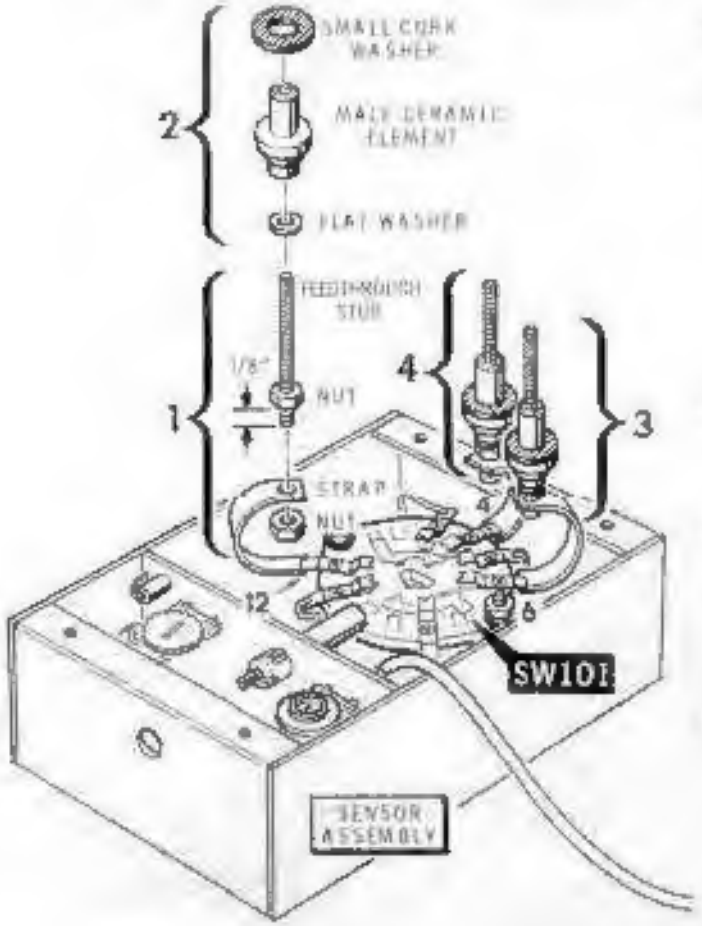
STEP-BY-STEP ASSEMBLY

REAR PANEL ASSEMBLY

Refer to Pictorial 1-1 (Illustration Booklet, Page 3) for the following steps.

( ) Locate the sensor assembly and position it as shown in Detail 1-1A. CAUTION: DO NOT ATTEMPT TO ADJUST OR IN ANY WAY TAMPER WITH THE SENSOR COMPONENTS, EXCEPT AS DIRECTED IN THE FOLLOWING STEPS. This unit has been factory calibrated; any attempt to readjust its controls may void the Warranty.

( ) Locate the three packets containing the small ceramic feedthrough insulators (#71-2) and other parts. Open one of these packets and remove all of its contents. Replace the fiber washers with small cork washers. Use these parts in the following steps, and discard the fiber washers.



Detail 1-1A

Refer again to Detail 1-1A for the next four steps.

( ) 1. Place a nut on one end of a feedthrough stud. Turn the nut until 1/8" of the thread is beyond the nut. Push this end of the stud through the hole in the end of the strap coming from switch SW101 lug 12. Turn another nut onto the end of the stud to secure the strap, then grasp the inner nut with pliers as you tighten the outer nut with the wrench provided.

( ) 2. Place a flat washer onto the end of the stud, followed by a male ceramic element, and a small cork washer as shown.

( ) 3. In exactly the same manner, install a feedthrough stud on the end of the strap coming from switch SW101 lug 6. Place a flat washer, the male ceramic element, and a small cork washer on the stud.

( ) 4. In exactly the same manner, install the remaining feedthrough stud on the end of the strap coming from switch SW101 lug 4. Place a flat washer, the male ceramic element, and a small cork washer on the stud.

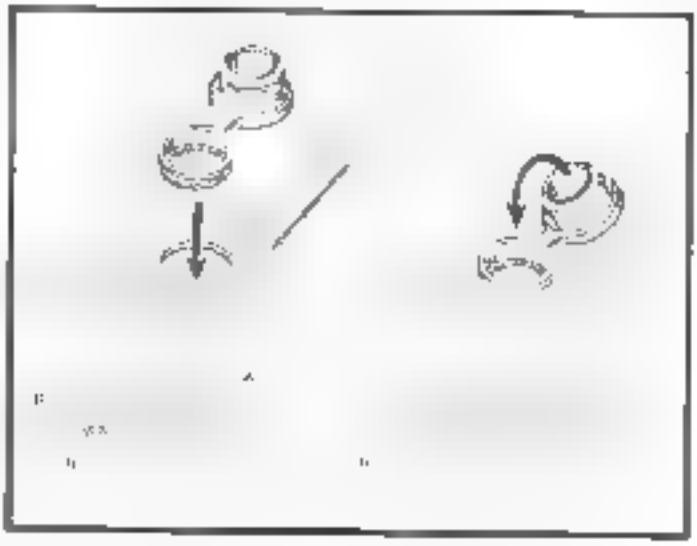
[illegible] Detail 1-1B and position the stud at lug 6 straight up, near the lower corner of the motor assembly as shown. You will have to bend the strap slightly to do this. Position the stud at lug 12 straight up, directly across the switch 2" from the stud at lug 6.

+ Refer again to Detail 1-1B and position the third stud at lug 4 straight up, so it is 1-3/8" from the stud at lug 12 and 1" from the stud at lug 6.

Before you mount the sensor, refer to the inset drawing in Detail 1-1B and make certain the rotor index is at the "bypass" setting **exactly** as shown. Then, do not move the rotor from this position during any later steps.

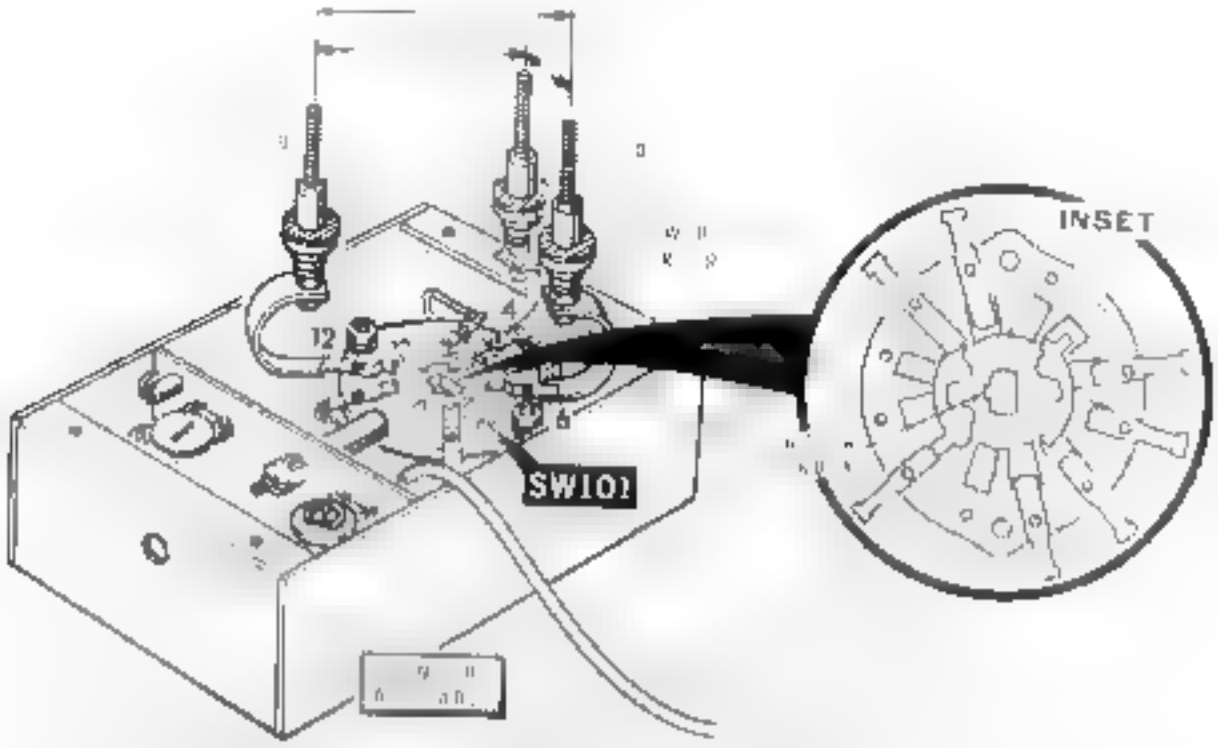
Position the chassis on your work area as shown in the Pictorial.

Refer to Detail 1-1C and install a 3/8" grommet in hole A from the outside of the panel as shown.



Detail 1-1C

1. Place the sensor assembly close to the rear of the chassis. Then push the end of the sensor cable into grommet A and pull the cable through to take up all the slack.



Detail 1-1B

NOTE: In the following steps, as you position the sensor assembly onto the rear panel, keep all the slack out of the cable; pull it through grommet A to avoid kinking it on the inside of the sensor assembly.

( ) Mount the sensor onto the rear panel so the three feedthrough studs are positioned into holes B, C, and D. Loosely secure the sensor housing to the rear panel with three #6 × 3/8" hex head sheet metal screws at E, F, and G.

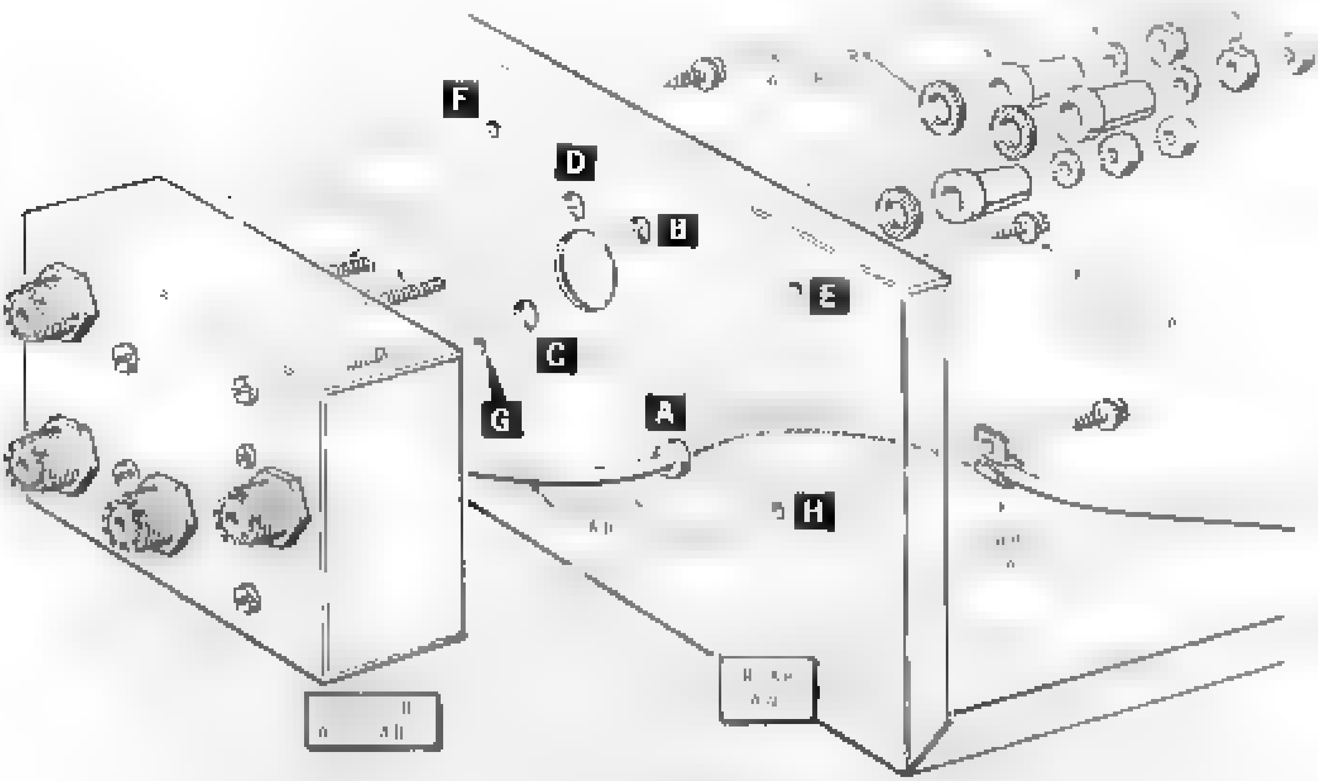
( ) Refer to Detail 1-1D and work the center portions of the three feedthrough insulators into holes B, C, and D. Then place a small cork washer, a female ceramic element, a fiber washer and a nut onto each feedthrough stud. Tighten each nut finger tight.

( ) Bend the rounded part of a cable clamp so it is just a little larger than the diameter of the sensor cable. Place the clamp onto the cable; then secure the clamp to the rear panel and the sensor at H with a #6 × 3/8" sheet metal screw. Position the cable and the clamp as shown in the [illegible] detail.

( ) Tighten the mounting screws at E, F, G, and H.

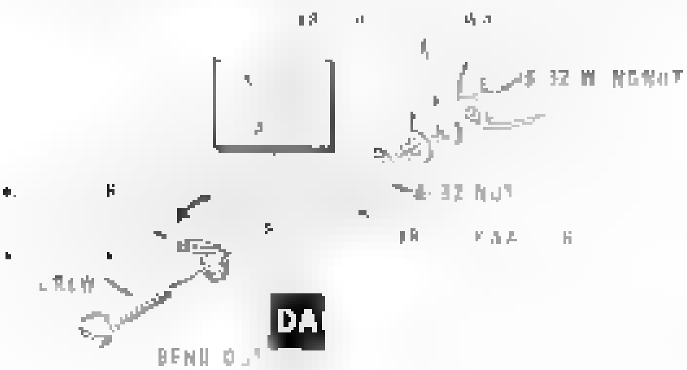
NOTE: In the following step, do not overtighten the [illegible] and crack [illegible].

( ) Turn the nut on each feedthrough [illegible] B, C, and D [illegible]. Then place [illegible] on the end of each [illegible].



Detail 1-1D

Heathkit



Detail 1-2A

Refer to Pictorial 1-3 (Illustration Booklet, Page 3) for the following steps.

( ) 1. Form a #6 solder lug as shown in Detail 1-2A. Then mount the solder lug at LA on the chassis rear panel as shown in the Detail. Use 6-32 x 5/16" hardware, two #6 steel flat washers, and on[illegible] [illegible]

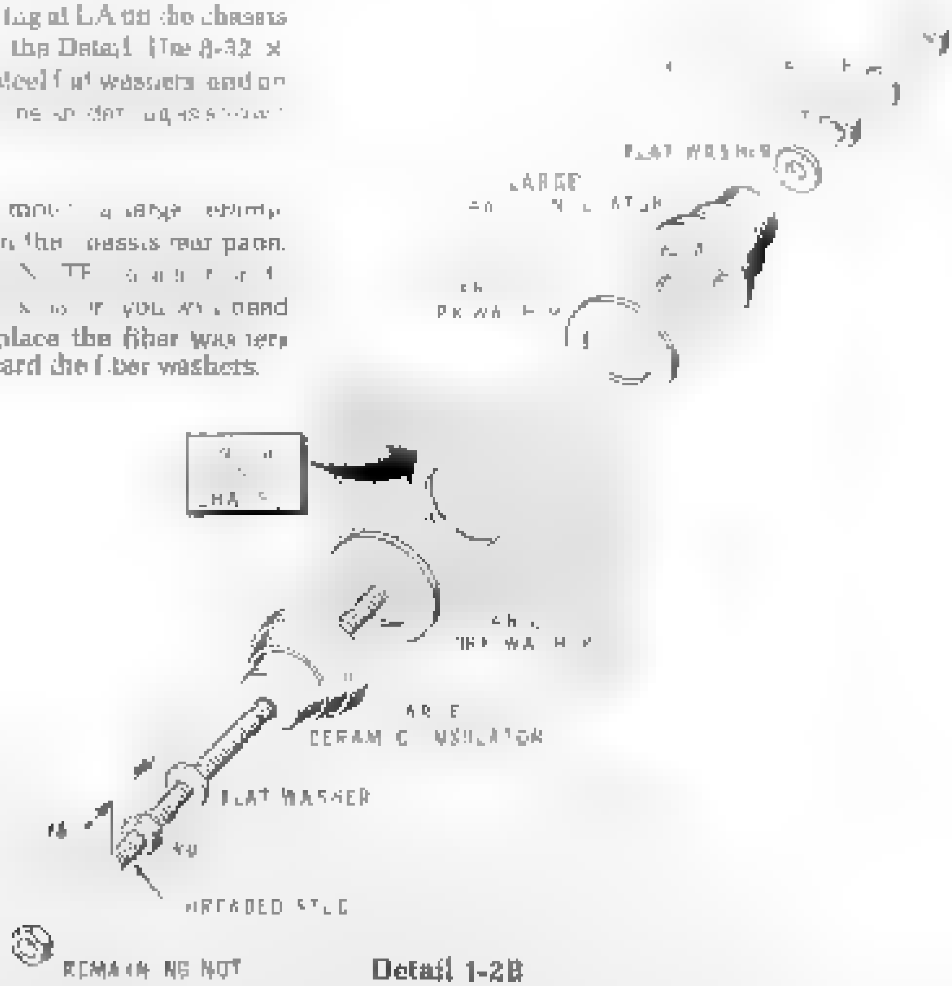
Refer to Detail 1-2B and mount a large ceramic feedthrough insulator [illegible] on the chassis rear panel [illegible] three steps. NOTE: [illegible] the parts supplied with [illegible] you [illegible] a #10 lockwasher. Also, replace the fiber washers with large cork washers. Discard the fiber washers.

[illegible] shown. Before you tighten the hardware, make sure about 1/4" of the threaded stud extends from the nut on the inside of the chassis. Do not overtighten the hardware.

( ) 2. Slide a #10 lockwasher onto the stud on the [illegible] lockwasher.

( ) 3. Temporarily start the remaining nut onto the stud on the inside of the chassis.

( ) J4 and J5. In the same manner, mount large ceramic feedthrough insulators at J4 and J5.



Detail 1-2B

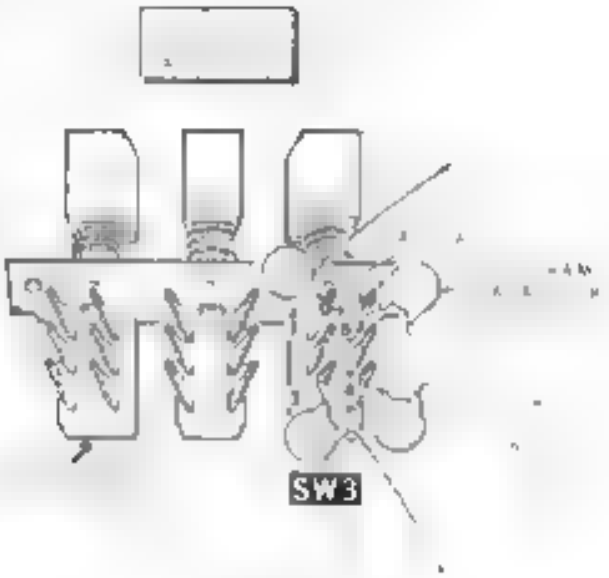
[illegible]

Refer again to Detail 1-21 and insert the shorting bar through insulators J4 and J3. Be sure the shorting bar is between the #10 flat steel washers. Also be sure the open side of the shorting bar is on the stud of J3 as shown.

[illegible] Set the chassis assembly aside temporarily.

Detail 1-21

Heathkit



PICTORIAL 2-1

SWITCH PREWIRING

Refer to Pictorial 2-1 for the following steps.

1. Place the pushbutton switch assembly upside down as shown.

2. On each of the four .01 µF ceramic capacitors cut one lead to 1/4". Form a loop in the end of each 1/4" lead.

NOTES:

1. In the following steps you will connect the four prepared .01 µF capacitors to SW 1 lugs. These are the straight caps, without loops on the top of the switch, as shown in the Pictorial.

In the following steps, NS means not to solder because other wires will be soldered later. "S" with a number such as (S-1), means to solder to connection. The number following the "S" tells how many wires are at the connection.

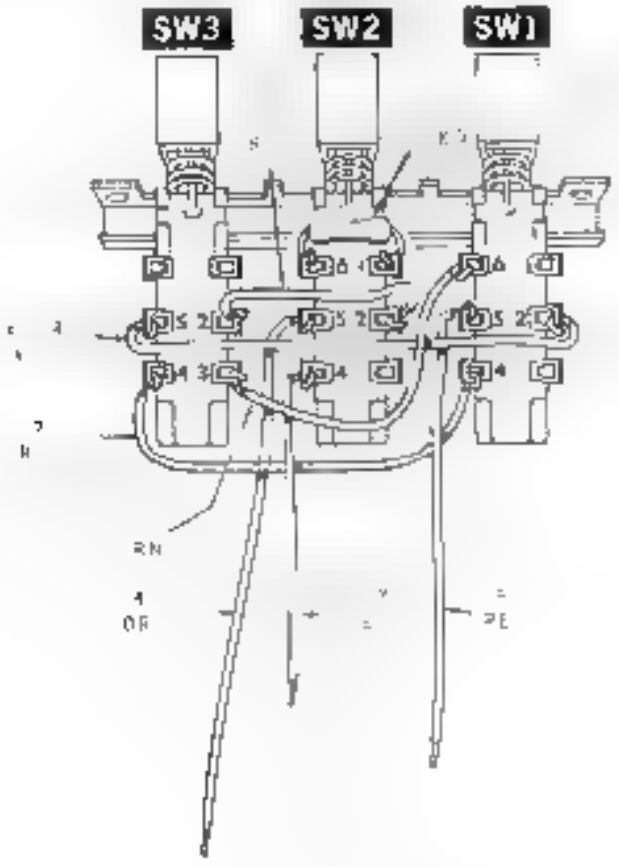
( ) C6 .01 µF ceramic capacitor to SW3 lug 6 (S-1)

( ) C5 .01 µF ceramic capacitor to SW3 lug 4 (S-1)

( ) C3 .01 µF ceramic capacitor to SW3 lug 1 (S-1)

( ) C4 .01 µF ceramic capacitor to SW3 lug 3 (S-1)

NOTE: The free capacitor leads will be connected later.



PICTORIAL 2-2

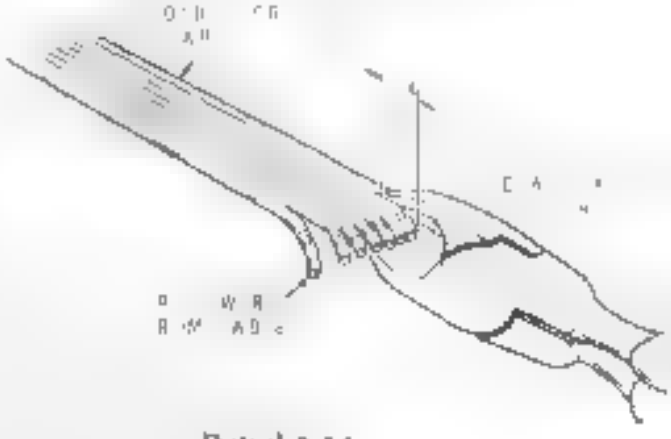
Refer to Pictorial 2-2 and Pictorial 2-3 during the following steps.

1. Position the pushbutton switch assembly [illegible]

2. Cut the leads of a 16.5 kΩ brown-blue-orange resistor to 1.6". Bend both leads to form a 90-degree angle to the body of the resistor then form a small hook on the end of each lead.

3. R2. Connect the prepared 16.5 kΩ resistor between switch SW2 lugs 1 (S-1) and 6 (S-1). NOTE: Be sure the resistor leads touch only the designated switch lugs. Cut off any excess lead ends.

Refer to Detail 2-2A and cut and separate the individual wire ends, using diagonal cutters, on one end of the 8-conductor cable about a [illegible] will have eight separate wires. NOTE: You will use these wires to continue wiring your kit.



Detail 2-2A

NOTE: When you are instructed to prepare a stranded wire as in the following step, cut the wire to the length indicated and remove 1/4" of insulation from each wire end. Then, lightly twist the wire ends and apply a small amount of solder to hold the fine strands together.

( ) Prepare the following stranded wires:

+ [illegible]
4 [illegible] 2 [illegible]
4 violet 3" red
and [illegible]

( ) Connect one end of a 4" orange wire to switch SW2 lug 5 (S-1). Route the free end of the wire as shown. It will be connected later.

Connect a 1 4" blue wire from SW3 lug 2 (S-1) to SW2 lug 2 (S-1).

Connect a 2-1/4" violet wire from SW1 lug 5 (S-1) to SW1 lug 2 (S-1).

Connect a 2" green wire from SW3 lug 3 (S-1) to SW1 lug 6 (S-1).

Connect a 2" wire from SW3 lug 4 (S-1) to SW1 lug 4 (S-1).

NOTE: In the following steps, temporarily move any switch wires as necessary to allow adequate room to solder other connections.

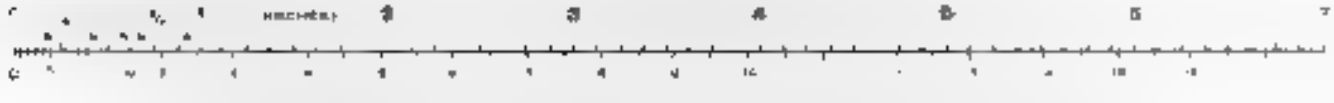
( ) Connect one end of a 3-1/2" yellow wire to switch SW2 lug 4 (S-1). Route the other end of the wire as shown. It will be connected later.

( ) Connect the free end of a 3" red wire to switch SW1 lug 5 (S-1). Route the free end of the wire as shown. It will be connected later.

FRONT PANEL ASSEMBLY

Refer to Pictorial 2 (Instruction Booklet Page 4) for the following steps.

( ) Position the chassis as shown.



Refer to Detail 2-3A and mount the pushbutton switch assembly on the front panel at SW1, SW2 and SW3 in the following steps.

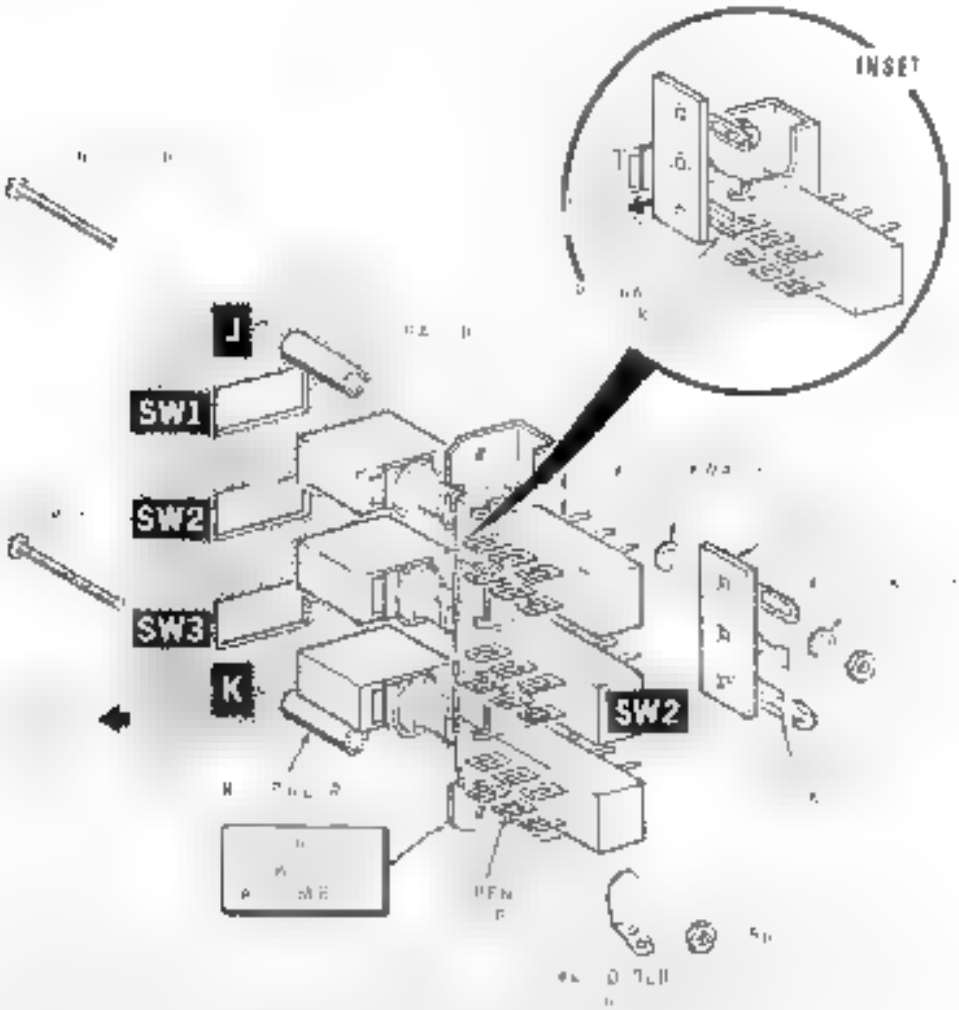
Position the switch assembly into the front panel so the open loops are toward the left side of the chassis.

Cut the indicated lug of the terminal strip in half as shown. Discard the cutoff lug.

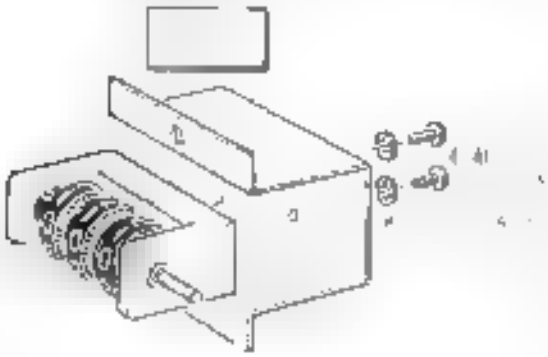
Secure the top of the switch assembly at W with a 2-56 x 11/16" screw, a 3/8" spacer, a #2 lockwasher, the terminal strip, a #2 lockwasher and a 2-56 nut. Position the cut terminal strip lug onto the top inner switch lug as shown in the inset drawing. NOTE: Pull outward on the terminal strip before you tighten the mounting screw.

Secure the bottom of the switch assembly at K with a 2-56 x 11/16" screw, a 3/8" spacer, a #4 solder lug, and a 2-56 nut. Position the solder lug straight down as shown in the Pictorial.

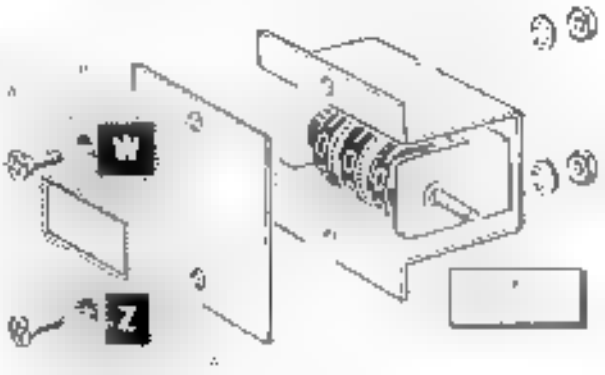
Push each pushbutton in and out to make sure none of them bind in the front panel. If necessary, temporarily loosen the switch mounting hardware and move the switch assembly as necessary. Then retighten the mounting hardware.



Detail 2-3A



Detail 2-3H



Detail 2-3I

( ) **Refer to detail 2-3B** and mount the counter to the counter bracket. Use two 4-40 × 5/16" screws and two #4 lockwashers. Be sure the edges of the counter are parallel to the edges of the bracket before you tighten the screws.

NOTE: When hardware is called for in a step, only the screw size will be given. For instance, if 6-32 × 1/4" hardware is called for, use a 6-32 × 1/4" screw, one or more #6 lockwashers, and a 6-32 nut. The Parts List or Detail will show the number of lockwashers to use. Use the plastic nut starter to pick [illegible] screws.

( ) Locate the small window and, if necessary, remove the thin protective film from either or both sides of the window.

( ) Refer to Detail 2-3C and mount the counter assembly and the window to the front of the chassis at W and Z, using 6-32 × 3/8" flat head hardware as shown.

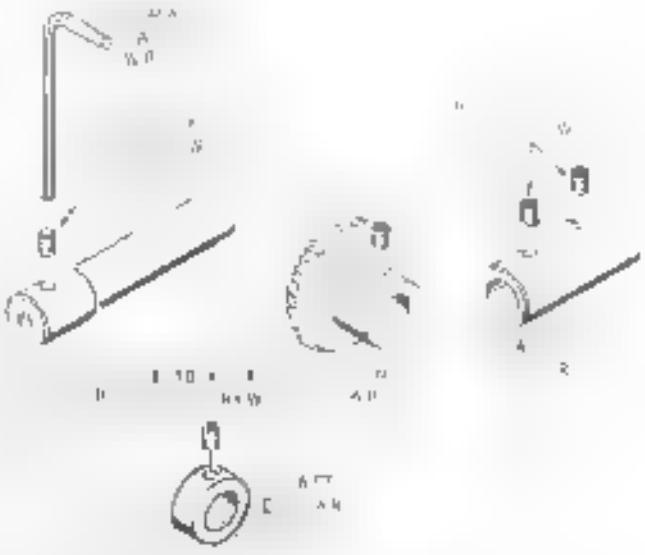
( ) Refer to Detail 2-3D and use the small Allen wrench to start a 4-40 × 1/8" setscrew in the stepper coupler.

( ) Start a 4-40 × [illegible] setscrew [illegible] on gears.

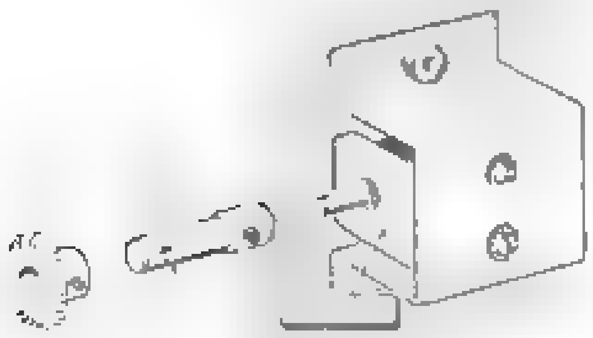
( ) Start a 4-40 × 1/8" setscrew into the shaft collar.

Use the large Allen wrench to start two 6-32 × 3/16" setscrew[illegible] into each of the four shaft [illegible].

Set the shaft spacing gauge [illegible] the four shaft couplers aside until they are [illegible] for the next step.



Detail 2-3D



Detail 2-3F

CAUTION: You can very easily strip the threads in the screw holes in the nylon gears when you mount them on their shafts as in the next step. Therefore, do not overtighten the setscrews when you secure the gears to their shafts.

( ) Refer to Detail 2-[illegible]F and mount a nylon gear onto the stepped coupler as shown. Be sure the setscrew enters the recessed area on the coupler. Then carefully tighten the setscrew.

( ) Turn the shaft of the counter until you can read 000 through the front panel window. Then temporarily mount the stepped coupler onto the shaft of the counter. Push the stepped coupler all the way onto the shaft of the counter before you tighten the setscrew. Tighten the setscrew only enough to hold the coupler in place.

FRONT PANEL WIRING

Refer to Pictorial 2-4 (Illustration Booklet, Page 5) for the following steps.

( ) Locate the spiral shield (#206-406). Pull on the ends of the shield and stretch it evenly to a length of 26".

( ) Refer to Detail 2-4A and, at both ends of the spiral shield, straighten the spiral for a length of 1/2". Then form a small hook in the wire end as shown.

( ) Straighten out the sensor cable coming from rear panel grommet A. Now cut the cable to a length of 27" (from the cable clamp on the rear panel). Discard the excess cable.

( ) Remove 1-1/2" of outer insulation from the sensor cable. Be careful not to cut into the inner wire insulation when you cut the outer insulation.

( ) Tightly twist together the wire ends of the sensor cable (a tightly-wrapped piece of tape may be helpful). Then push the free end of the cable all the way through the spiral shield until the rear end of the shield touches cable clamp H on the rear panel.

( ) Temporarily refer to Detail #2 on Pictorial 2-4 (Illustration Booklet, Page 12) and connect the hook on the rear end of the spiral shield to the inner side of cable clamp H.

( ) At the front end of the spiral shield, untwist the bare ends of the sensor cable.

( ) Cut off the black wire [illegible]

( ) Prepare the five sensor cable wire ends.

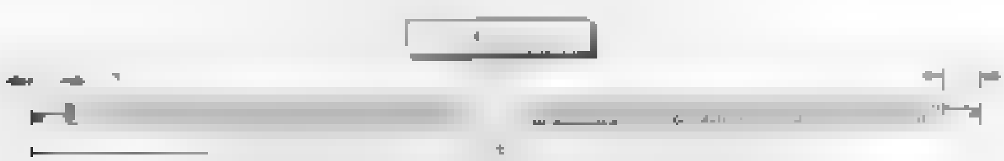
Connect the free ends of the sensor cable and the wire end of the spiral shield as follows:

( ) Connect the hook on the free end of the spiral shield to solder lug K (NS).

( ) Connect the end of the black wire to [illegible] K (NS).

( ) Connect the end of the brown wire to SW[illegible] lug [illegible] (S-1).

( ) Connect the end of the white wire to SW[illegible] lug [illegible] (S-1).



Detail 2-4A

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[ ] Connect the end of the red wire to SW3 lug 4 (S-2).

[ ] Connect the end of the green wire to SW3 lug 3 (S-2).

Refer to Pictorial 2 (Illustration Booklet Page 5) for the following steps.

NOTE: In the following steps you will connect the previously installed .01 µF capacitors coming from the lugs of switch SW3 to solder lug K.

[ ] (S-5) SW3 lug 6 to solder lug K (NS).

[ ] (S-5) SW3 lug 4 to solder lug K (NS).

[ ] (S-4) SW3 lug 1 to solder lug K (NS).

[ ] (S-4) SW3 lug 3 to solder lug K (S-6). NOTE: Use enough solder and heat to assure a good connection on all six leads and wires at the solder ... both wire and lead and wiggle it to be ... [illegible] ... sure it is soldered. Reheat the connection if necessary.

[ ] Check the connection on the back of SW1 to make sure that the two outside ends of the capacitor leads touch one another and that none of them are shorted to other switch lugs. Reposition the capacitor leads if necessary.

[ ] Cut both leads of a 470 Ω 1/2 W (yellow-violet-brown) resistor to 1/2". Refer to Detail 2-5A and form the resistor leads as shown.

Detail 2-5A

[ ] R1. Place one of the 470 Ω 1/2 W resistor leads into the eyelet at lug 1 of terminal strip 1 as shown in the Pictorial (S-1). Carefully cut the end of the other resistor lead so it just goes through the eyelet at terminal strip lug 1. Solder the lead to the eyelet. Cut any excess lead length from terminal strip lug 1.

[ ] Carefully check the space between the inside of the terminal strip and the top of the switch assembly. If necessary, bend the terminal strip outward slightly so the terminal strip lugs will not short to the frame of the switch assembly.

[ ] Bend the top of terminal strip 1 lug 2 downward onto switch SW1 lug 1. If this has not already been done. Be sure the terminal strip lug touches only the designated switch lug. Solder the connection.

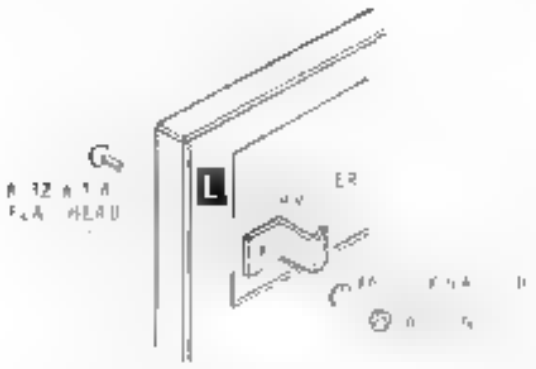
[ ] Prepare the following sizes of wire:

3 green
4 1/2 gray

[ ] Connect one end of a 4-1/2" gray wire to terminal strip 1 lug 2 (S-2). Route the free end of the wire as shown. It will be connected later.

[ ] Connect one end of a 4" brown wire to terminal strip 1 lug 3 (S-1). Route the free end of the wire as shown. It will be connected later.

[ ] Check all pushbutton switch and terminal strip connections to make sure they are well soldered, that all wire assembly and bare leads are cut off, and that no wires or leads are strained to adjacent connections. NOTE: The free ends of the six wires coming from the pushbutton switch assembly and terminal strip will be connected later.



Detail 2-6A

Refer to Pictorial 2-6 (Illustration Booklet Page 6) for the following steps.

1. Refer to Detail 2-6A and mount a meter bracket on the rear panel as shown. Use a #6-32 x 3/8" flat head machine screw to loosely start the nut on the end of the screw. It will be tightened later.

In the same manner, loosely install meter bracket at the P and R.

Refer to Detail 2-6B for the next seven steps.

NOTE: In the following steps, be sure to place the meters on a soft cloth whenever possible to avoid scratching the meter faces.

2. Remove both meters from their shipping cartons. Discard the meter mounting hardware and discard the shorting wires from the meter terminals.

3. Cut four 1/2" pieces of masking tape.

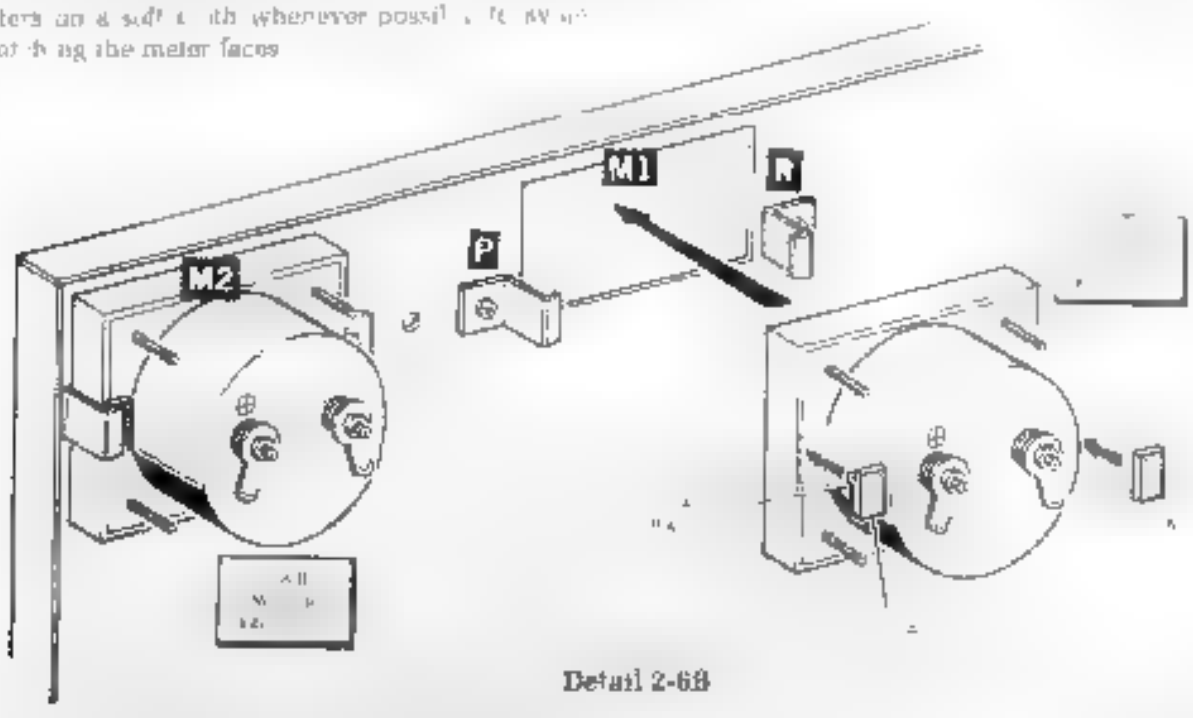
4. Remove the paper backing from one side of a piece of tape. Place the tape over the [illegible] on the L meter. Be sure the tape does not cover the meter terminals.

5. Press until the tape is out of sight at the bottom of the meter.

6. In the same manner, place the remaining 1/2" pieces of tape on the sides of the meter.

7. M1 Position the RFP meter (#402-3718) on the meter bracket at M1 as shown in Detail 1. Secure the sides of the meters with bracket P and R as shown. Tighten the bracket screws.

M2. In the same manner, mount the FWD meter (#402-3718) M2 as shown in the drawing.



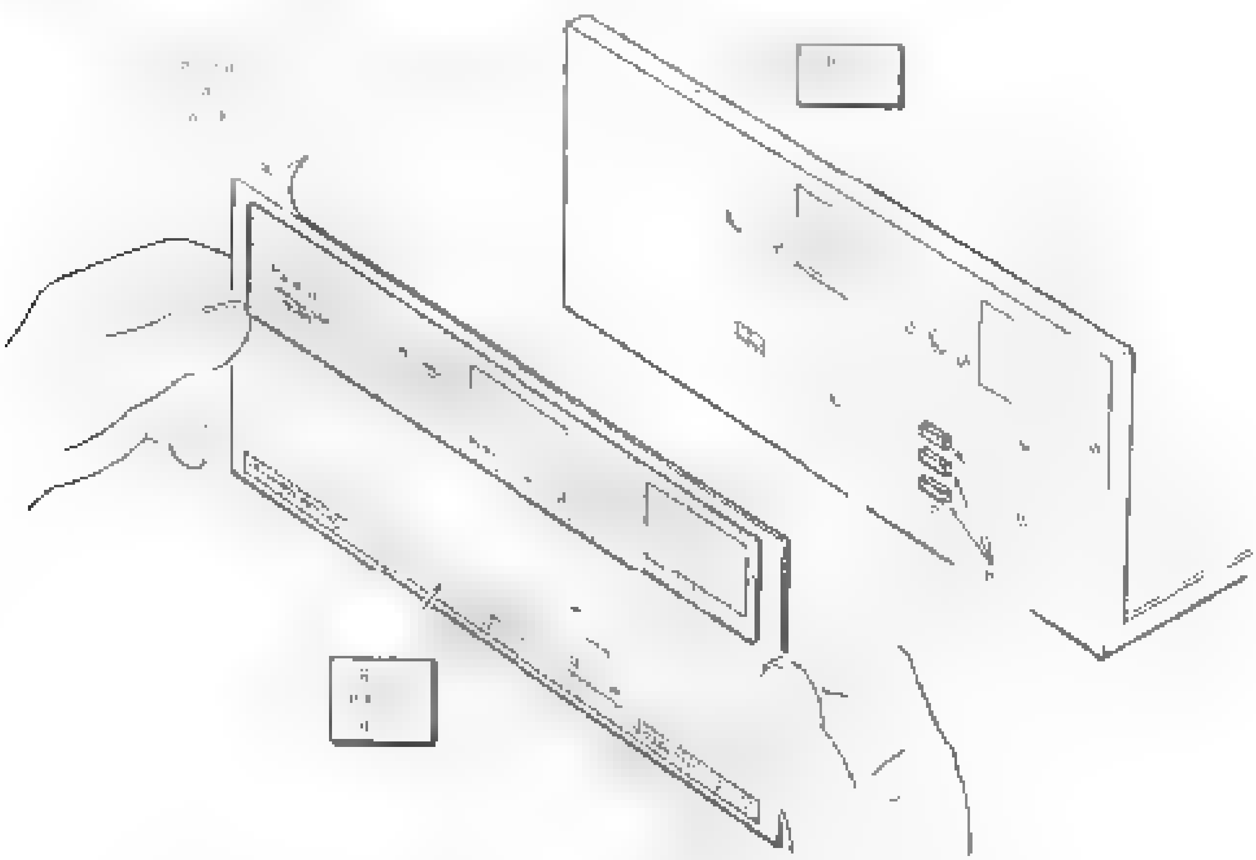
Detail 2-6B

( ) Position the meter lugs as shown in the Pictorial. Then tighten the lug hardware, if this has not already been done. Be careful not to overtighten the hardware or you could damage the meter.

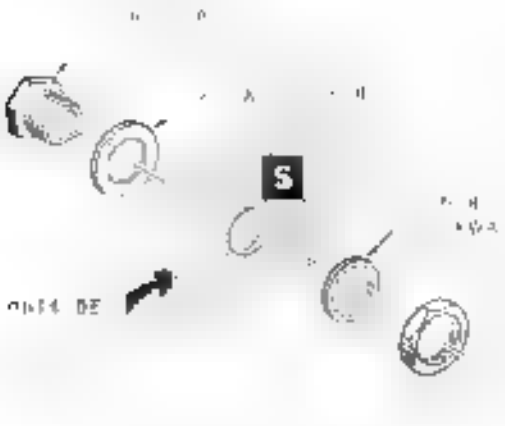
( ) Depress the three switch pushbuttons to their [illegible]

NOTE: When you install the front panel label in the following step, do not press the label onto the front panel until you are absolutely certain it is positioned correctly. When the label's adhesive backing touches the surface of the front panel, it will be difficult to remove and reposition it.

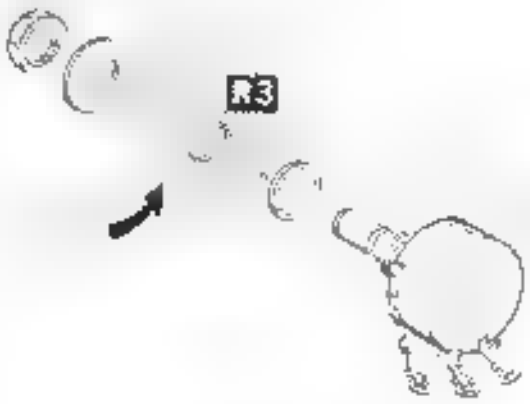
( ) Refer to Detail 2-6C and remove the paper backing from the front panel label. Hold the label stretched between both hands. Carefully lower it onto the front panel, paying particular attention to the counter switch assembly and meter cutouts. Lower the label onto the front panel. Then, working from the center outward in both directions, smooth the label firmly onto the front panel.



Detail 2-6C



Detail 2-6D



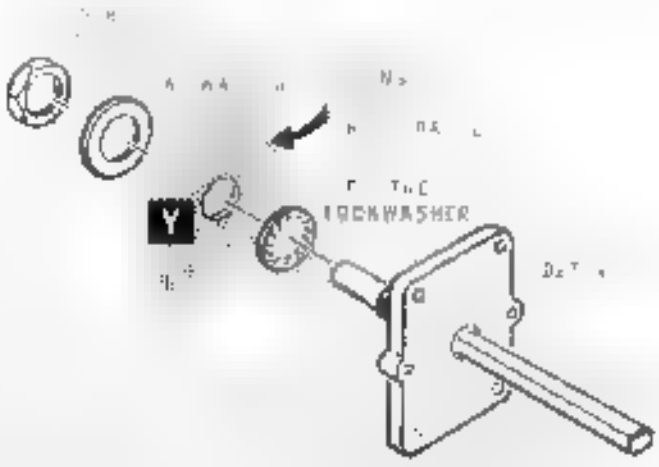
Detail 2-6E

NOTE: In the next two steps, if the flat washer does not fit onto the brass bushing, you may discard the washer.

Refer to Detail 2-6D and loosely install a short shaft bushing in the front panel at S. Use a control flat washer, a control lockwasher and a control nut.

Refer to Detail 2-6E and place a control lockwasher on the switch detent and install the detent in front panel hole Y. Secure the detent with a control flat washer and a control nut (tighten the hardware). Point up the detent as shown in the Pictorial.

In the same manner, loosely install short shaft bushings at T and X.



Detail 2-6F

Refer to Pictorial 2-7 (Illustration Booklet Page 7) for the following steps.

NOTE: When a wire or wires pass through one connection to another connection, each wire at the first connection will be counted as two wires in the solder instructions, one entering and one leaving the connection.

1) Remove an additional 1/4" (total 1/2") of insulation from the free end of the red wire coming from switch SW1 lug 5. Route this wire around terminal strip 1 as shown. Then pass the bare end of this wire through control R3 lug 2 (S-2) to lug 3 (S-1).

2) Route the yellow wire coming from switch SW2 lug 4 around terminal strip 1 as shown. Then connect the bare end of this wire to control R4 lug 1 (S-1).

3) Connect a .001 µF ceramic capacitor between meter M1 lugs 1 (NS) and 2 (NS). Position the capacitor as shown. Cut off the excess lead length.

4) In the same manner, connect a .001 µF ceramic capacitor between lugs 1 (NS) and 2 (NS) of meter M.

5) Connect the free end of the orange wire from SW2 lug 5 to meter M1 lug 1 (S-2).

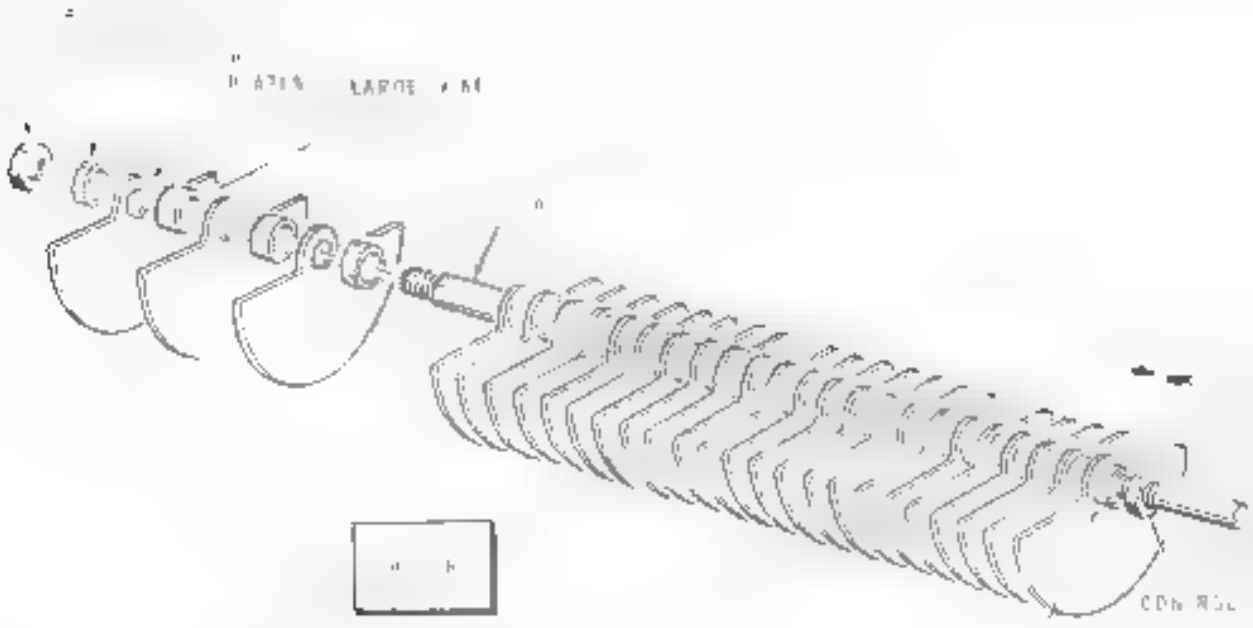
6) Connect the free end of the bright gray wire coming from terminal strip 1 lug 2 to meter M lug 2 (S-2).

7) Connect the free end of the slender gray wire coming from terminal strip 1 lug 2 to meter M1 lug 2 (S-2).

8) Connect the remaining bare wire coming up from terminal strip 1 lug 2 to meter M2 lug 1 (S-2).

9) Check all of the wiring on the front panel. Make sure each wire is soldered properly to its lug or terminal.

This completes the front panel wiring. Set the chassis assembly aside temporarily.



PICTORIAL 3-1

TRANSMITTER AND ANTENNA MATCHING CAPACITORS (C1 and C2)

Refer to Pictorial 3-1 for the following steps.

NOTE: In most of the following steps you will find a double check-off space ([ ]). One will be used for C1 and the other for C2. Perform all of the steps for one section (or both sections) at the same time.

1. [ ] [ ] Locate the following parts:

   Two control nuts
   One 9-7/8" hex shaft
   Two large 3/16" spacers
   25 large 17/64" spacers
   26 rotor plates

   Use the following procedure to assemble the matching caps (for rotor assembly).

2. [ ] [ ] Turn a control nut onto the unthreaded end of the 9-7/8" hex shaft. Adjust this control nut so the outside of the nut is 1-15/16" from the end of the unthreaded part of the shaft. Try not to disturb this nut when you perform the following steps.

3. [ ] [ ] Slide a large 3/16" spacer onto the shaft and against the control nut.

4. [ ] [ ] Match the hex shaped hole in a rotor plate with the hex shape on the shaft. Then slide the rotor plate onto the shaft until it is against the 3/16" spacer.

5. [ ] [ ] Slide a large 17/64" spacer onto the shaft and against the first rotor plate.

6. [ ] [ ] Match the hex shaped hole in a second rotor plate with the hex shape on the shaft. Match the position of the second plate with that of the first rotor plate. Slide the rotor plate onto the shaft until it is against the first 17/64" spacer.

7. [ ] [ ] Repeat steps 4 and 5 until you have 26 rotor plates and 25 large spacers installed on the shaft.

8. [ ] [ ] Place another large 3/16" spacer on the rear of shaft.

9. [ ] [ ] Use the remaining control nut to secure the rotor plates and the spacers on the shaft.

Set the rotor assembly aside temporarily.

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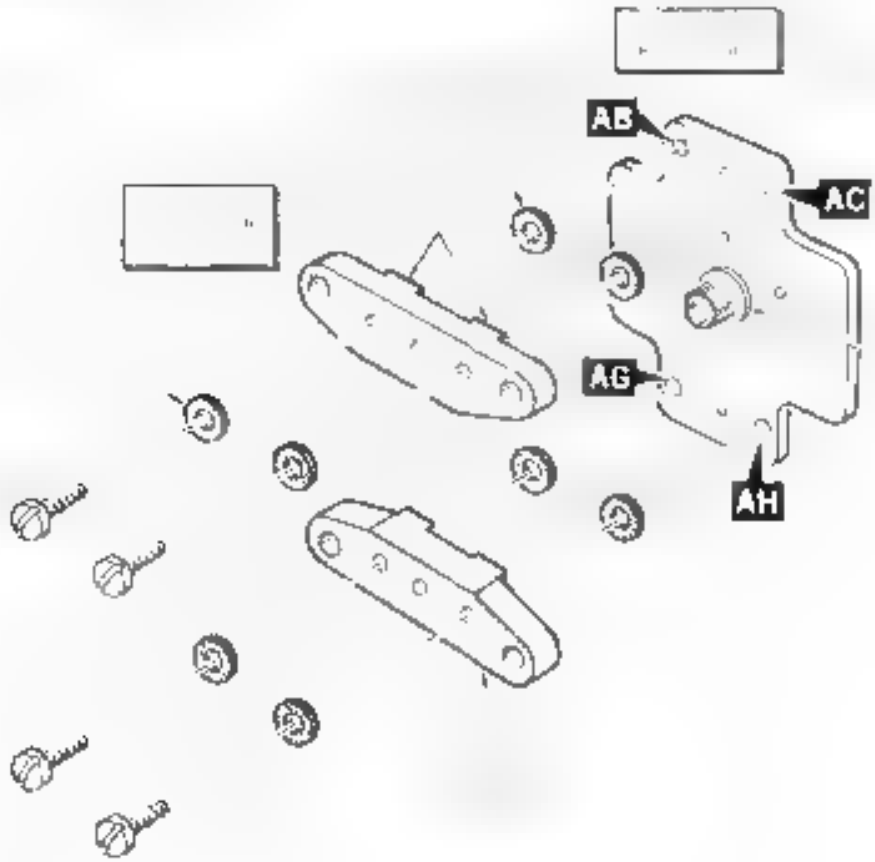


Detail 3-2A

Refer to Parts Illustration Booklet Page 8 for the following steps.

1. The ceramic insulator plates have two raised areas on one side. When you are instructed to mount these plates to a capacitor plate as in the next step, be sure you position the side with the raised area toward the capacitor plate. Also be sure you orient each insulator plate so its straight edge is positioned as shown in the Detail.

2. When you tighten the 6-32 x 1/2" screws to secure the capacitor insulator plate to a capacitor plate, do **not** overtighten the screws as you may break the ceramic insulator plate.

3. Refer to Detail 3-2A and position a ceramic insulator plate on a capacitor **front** plate at AB and AC. Use an 6-32 x 1/2" screw, one #8 flat fiber washer at each of the two holes. Make sure you install the insulator plate on the same side as pictured as shown. And hold this side of the front plate against a flat surface when you tighten the screws. This will make sure the top edge of the ceramic insulator plate is flush with the top edge of the capacitor front plate.

4. Similarly mount another ceramic insulator plate on the capacitor front plate at AG and AH.

( ) Locate the following parts:

- Two 10-32 × 6-7/8" threaded brass rods
- Four #10 flat fiber washers
- Eight 10-32 nuts
- Two small 3/16" spacers
- 50 small 17/64" spacers
- 25 stator plates
- One capacitor front plate assembly (assembled in a previous step)

NOTE: In the following steps, you will assemble a matching capacitor stator assembly. Carefully assemble the parts as shown in the Pictorial. Be sure each part is in its proper position, and that you tighten the indicated nuts properly.

Assemble the stator section of the matching capacitor as follows.

( ) 1. Start a 10-32 nut onto one end of each threaded rod. Turn one of these nuts onto each threaded rod until it is all the way onto the threaded portion of the rod. Back this nut off until **two threads** are exposed.

( ) 2. Start a second 10-32 nut onto each threaded rod. Position the nut 3/16" from the first nut as shown. NOTE: This nut may be adjusted later.

( ) 3. Slide a #10 flat fiber washer onto the end of each threaded rod.

( ) 4. Position the capacitor front plate assembly as shown (note the position of the ceramic insulator plates and the three indicated holes). Then insert the ends of the threaded rods (that have the nuts) through holes AA and AJ in the indicated ceramic insulator plate.

( ) 5. Slide a #10 flat fiber washer onto the end of each threaded rod.

( ) 6. Start a 10-32 nut onto the end of each threaded rod. Turn these nuts onto the rods until they are snug against the ceramic insulators and flat fiber washers. Do not overtighten the nuts and break the insulator.

( ) 7. Slide a 17/64" small spacer onto each threaded rod. [illegible] 17/64" spacers and [illegible] step [illegible].

( ) 8. Slide a stator plate onto the two threaded rods [illegible] the stator plate as shown in the Pictorial.

( ) 9. Repeat steps 7 and 8 until you have the [illegible] 25 stator plates [illegible].

( ) 10. Slide one of the small 3/16" spacers onto each threaded rod and start the last 10-32 nut on each rod. Tighten these nuts [illegible].

Refer to Pictorial 3-3 (Illustration Booklet, Page [illegible]) for the following steps.

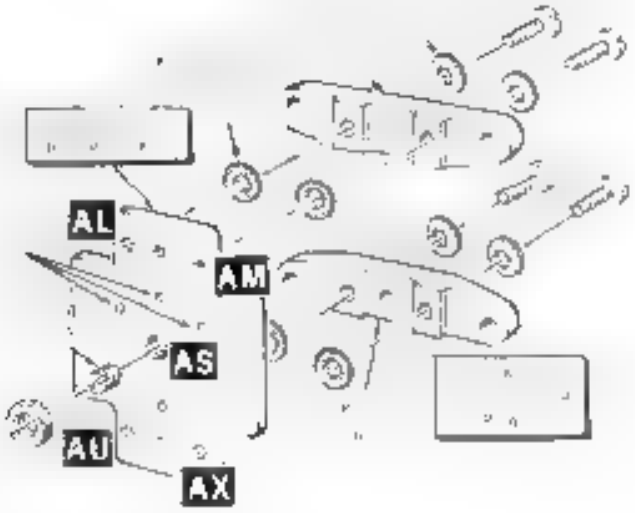
( ) Refer to inset drawing #1 on the Pictorial and identify the curved side of a dished spring. Then slide the spring onto the rotor shaft so the curved side is toward the rotor plates.

( ) Refer to Detail 3-3A and open the grease pack by cutting across one corner and into the pack as shown. [illegible]

( ) Squeeze out an amount of grease equal to a medium-size pea. Then use a toothpick and spread the grease on the [illegible] locations shown on the Pictorial.

( ) Position the rotor and stator assemblies as shown in the Pictorial. Then push the rotor shaft through the bearing in the capacitor front plate as far as it will go.

Detail 3-3A



Detail 3-3B

( ) Refer to Detail 3-3B and mount a ceramic insulator plate to a capacitor rear plate at AL and AM. Use an 8-32 x 1 2" screw and two #8 flat fiber washers at each of the two holes. Note that this side of the rear plate will not sit flush against the ceramic insulator plate when you have tightened the screws. This will make the top edge of the ceramic insulator plate flush with the top edge of the capacitor rear plate.

( ) Next, mount another ceramic insulator plate to the capacitor rear plate at AL and AX. Use an 8-32 x 1 2" screw and two #8 flat fiber washers at each of the two holes.

( ) Refer again to Detail 3-3B and start a 1/4-32 x 1/4" setscrew into a 1/4-32 nut. Then insert the setscrew in hole AS. Turn the screw in until the unslotted end is flush with the outside of the plate. Do not tighten the nut yet.

( ) Position the capacitor assembly as shown in the Pictorial.

( ) Turn a second 10-32 nut onto each of the two threaded rods of the capacitor assembly. Turn each of these nuts until there is 1 16" space between the inner and outer nuts as shown in the Pictorial.

IMPORTANT: The rear plate assembly for C1 will be mounted differently than the rear plate assembly for C2. Mark each capacitor rear plate assembly for identification in one of the next two steps.

( ) To mark the rear plate assembly for capacitor C1 (rotor): Study Detail 3-3B carefully and note the location of the three small holes as compared to the larger center hole. Turn the assembly top [illegible] larger center hole. On the upper ceramic insulator plate, write "C1 TOP." Then, in a [illegible] step when you are finished with the end plate assembly, make sure the lettering is positioned upward.

To mark the rear plate assembly for capacitor C2 (stator): Make certain the assembly is positioned **exactly as shown** in Detail 3-3B with the three holes positioned **above** the larger center hole. On the upper ceramic insulator plate, write "C2 TOP." Be sure this lettering is positioned upward when the assembly is mounted after the capacitor main assembly in another step.

( ) Slide a #8 flat fiber washer onto the end of [illegible]

( ) Apply a small amount of grease in the recessed area in the end of the setscrew (installed in hole AS of the rear capacitor plate). Then place a steel ball in the recessed area of the rotor shaft.

[illegible]
[illegible] holding [illegible] in the [illegible] plate.
[illegible]
screws.

( ) [illegible]
[illegible]
[illegible] 6-32 × 5/8" screws, eight #6 flat fiber
[illegible]

[illegible] the setscrew in hole AS of the [illegible] rear plate only until you feel some [illegible] more. Now [illegible] the 4-32 nut at AS.

[illegible]
of the [illegible] for [illegible]

[illegible]
form the [illegible] part of each forked spring [illegible] exactly like the drawing. [illegible] the forked springs [illegible] the actual size [illegible]

( ) [illegible]
capacitor rear plate. NOTE: On capacitors [illegible] hole AP is below the center, the fork end of the spring will point upward.

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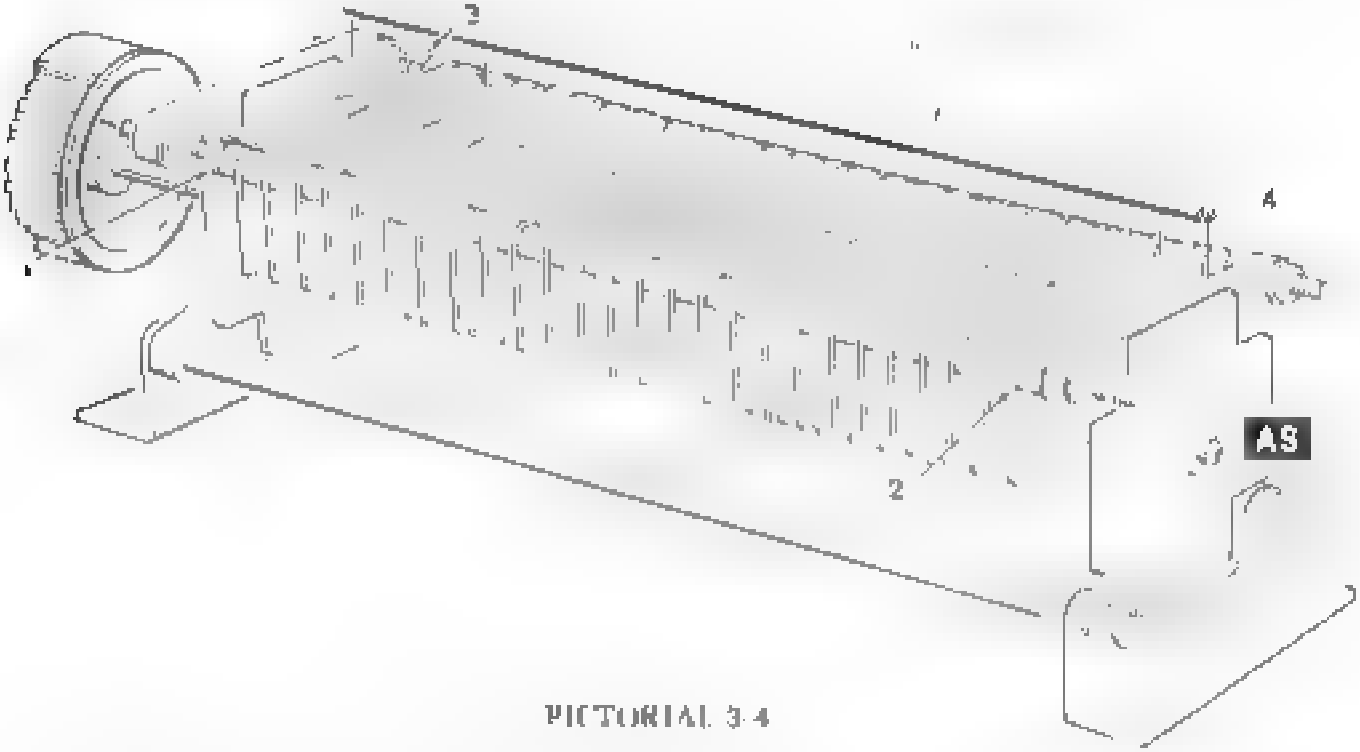


PICTORIAL 3-4

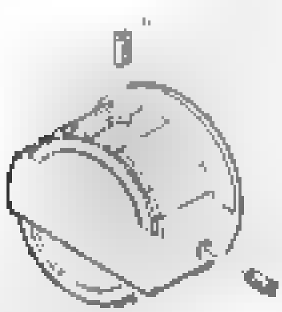
Refer to Pictorial 3-4 for the following steps.

( ) Position the capacitor assembly as shown in the Pictorial.

Refer to Detail 3-4A and start two 8-32 x 3/16" setscrews into each of the three large knobs.

( ) Push one of the knobs onto the capacitor shaft. Then temporarily tighten the two setscrews in the knob.

( ) Turn the capacitor shaft so the plates are fully [illegible].



Detail 3-4A

NOTE: In the following steps, first locate an unused 8-5/16" tapped spacer. Then use the spacer to check the top (inside) spacing of the top ceramic insulators as shown in Pictorial 3-4. Do this at both upper corners, close to each threaded brass rod.

( ) Turn nuts 1, 2, 3, and 4 (as necessary) to position each plate in the stator halfway between two corresponding rotor plates. Carefully inspect the capacitor assembly from one side, then the other side, to make sure each stator plate is positioned properly. Then tighten the four nuts.

( ) Turn the knob several times each way and note the torque needed to turn the shaft. This is the recommended tension adjustment. If you desire to have the shaft turn easier or harder, loosen or tighten the setscrew in the capacitor rear plate as desired. Keep in mind that the tension will loosen somewhat by itself during normal operation.

( ) ( ) Loosen the setscrews in the knob and remove the knob from the shaft. Set the knob aside [illegible].

This completes the assembly of the matching capacitor. Set the capacitor aside until it is called for in a step. If you have not assembled both capacitors, return to "Transmitter and Antenna Matching Capacitors (C1 and C2)" on Page 25 and complete the steps for the other capacitor. When you complete both capacitors, proceed to the following section.

ROLLER INDUCTOR (L1)

Refer to Pictorial 4-1 (Illustration Booklet Page 10) for the following steps.

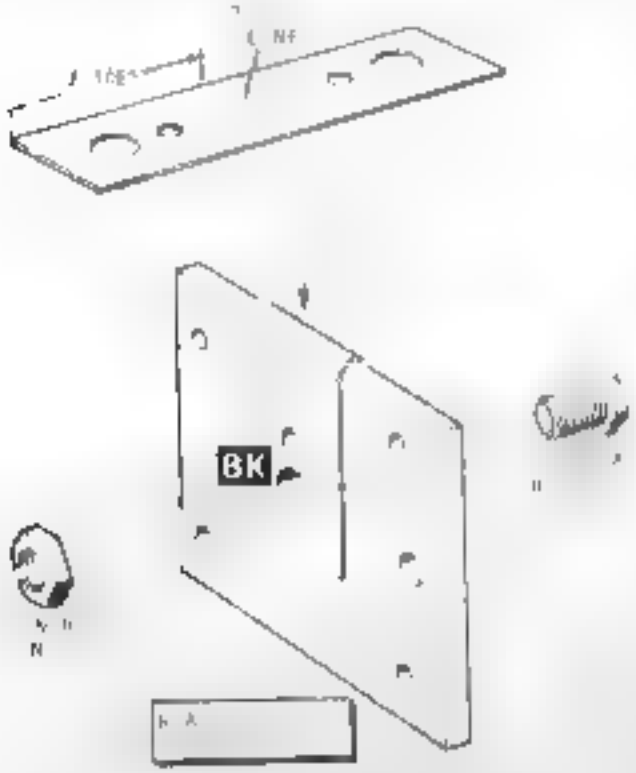
[ ] Peel the paper from both sides of the two inductor end plates.

[ ] Refer to Detail 4-1A and make a pencil line across the center of the 4-1/4" strap. NOTE: The pencil line will help you bend the strap in the middle when you mount it later.

[ ] Position one of the inductor end plates as shown in Detail 4-1A (note the position of the seven holes in the plate).

[ ] Bend the 4-1/4" strap over the indicated edge of the inductor end plate. Secure the strap to the plate at hole BK with a long shaft bushing and a control nut. Be sure the small holes in the strap line up with the corresponding holes in the inductor end plate before you tighten the hardware.

NOTE: The inductor end plate you just prepared will be referred to as the **rear** inductor end plate. Set the rear inductor end plate aside temporarily.



Detail 4-1A

[ ] Position the remaining inductor end plate as shown in Detail 4-1B (note the position of the seven holes in the plate).

[ ] Refer to the inset drawing on Detail 4-1B and straighten the control solder lug. Then mount the control solder lug at hole BC with a long shaft bushing and a control nut. Tighten the nut only finger tight at this time.

[ ] Mount an 8-32 x 3/8" tapped spacer to the rear inductor end plate at BA. Use an 8-32 x 5/8" screw, a #8 lockwasher and a #8 flat steel washer. Tighten the screw only finger tight.

[ ] Mount a capacitor mounting bracket to the inductor end plate at BE and BF. Use an 8-32 x [illegible] #8 solder lug and a #8 flat steel washer at BF. Use an 8-32 x 3/8", 6" tapped spacer an 8-32 x 5/8" screw, a #8 lockwasher and a #8 steel washer at BF. Tighten these screws only finger tight. Position the solder lug at BF straight up toward the spacer at BA.

[ ] Refer to Detail 4-1C and position the control solder lug at BC so it touches the #8 solder lug at BE. Then solder these lugs together. Now tighten the control nut at BC.

[ ] Note that the bushing on one end of the roller inductor is longer than the bushing at the other end. Apply grease to the shaft at this end of the inductor.

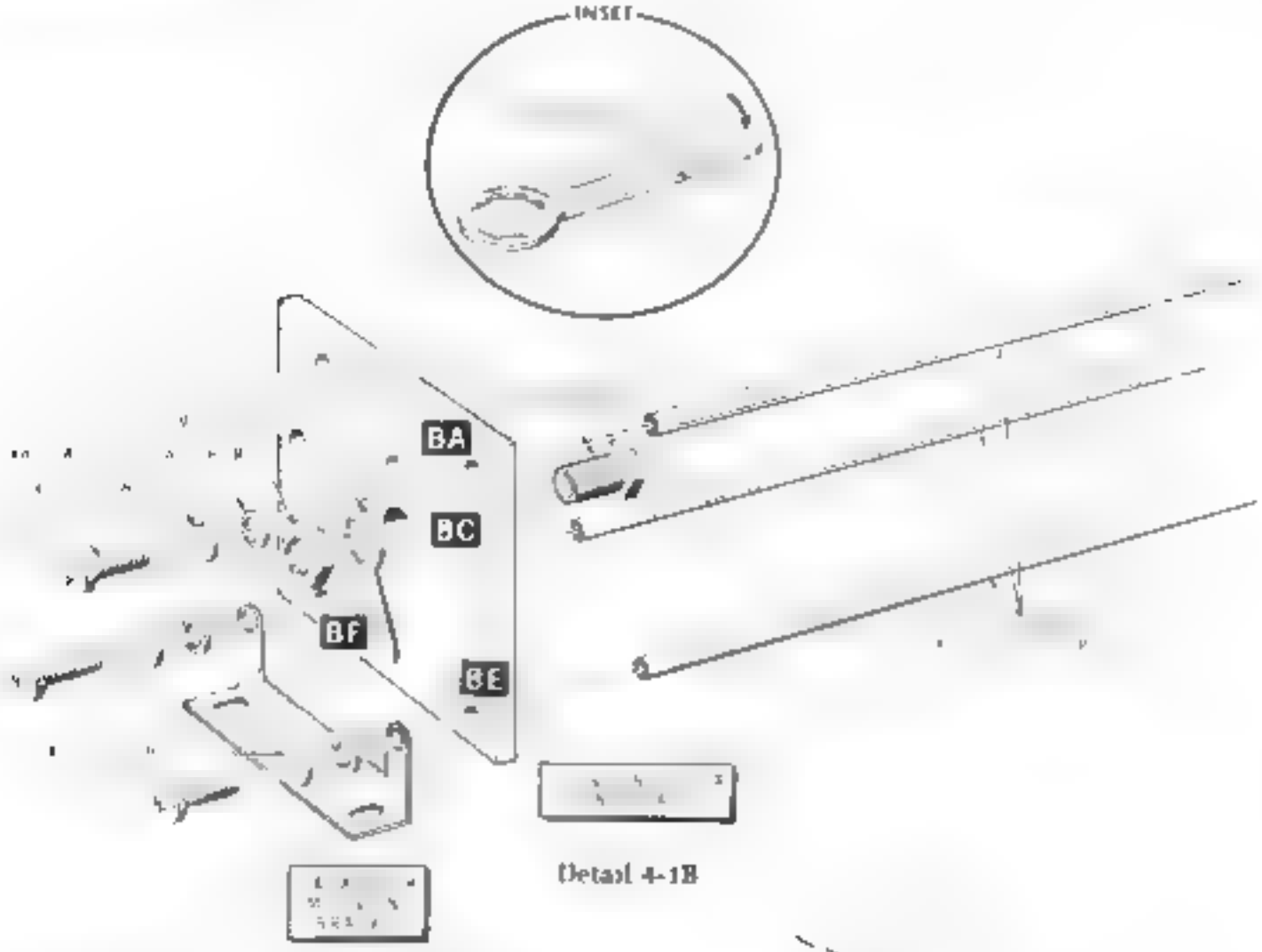
[ ] Slide the shaft at the greased end of the roller inductor into the bushing at BC in the front inductor end plate.

[ ] Slide the shaft roller onto the rear shaft of the roller inductor. Do not tighten the setscrew in the collar at this time.

[ ] Refer to the inset drawing on the Pictorial and identify the curved side of the brass spring washer. Then slide the spring washer on the rear shaft of the roller inductor with the curved side of the spring washer toward the inductor.

[ ] Apply grease to the rear shaft end of roller inductor.

[ ] Slide two contactor springs onto the spacer mounted at BF. Be sure to position these springs as shown in the Pictorial.

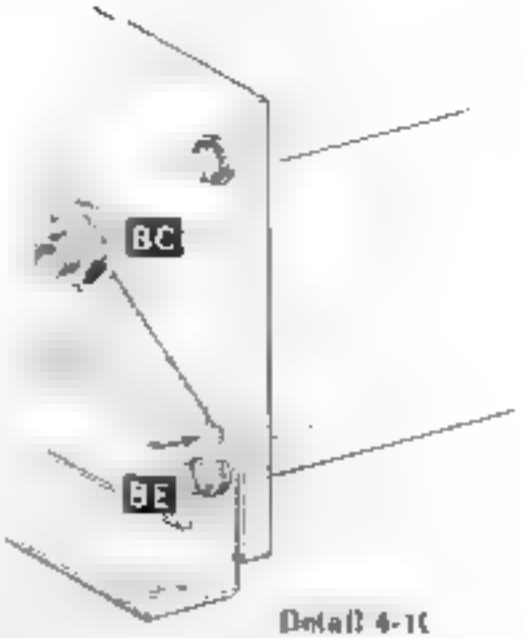


Detail 4-1B

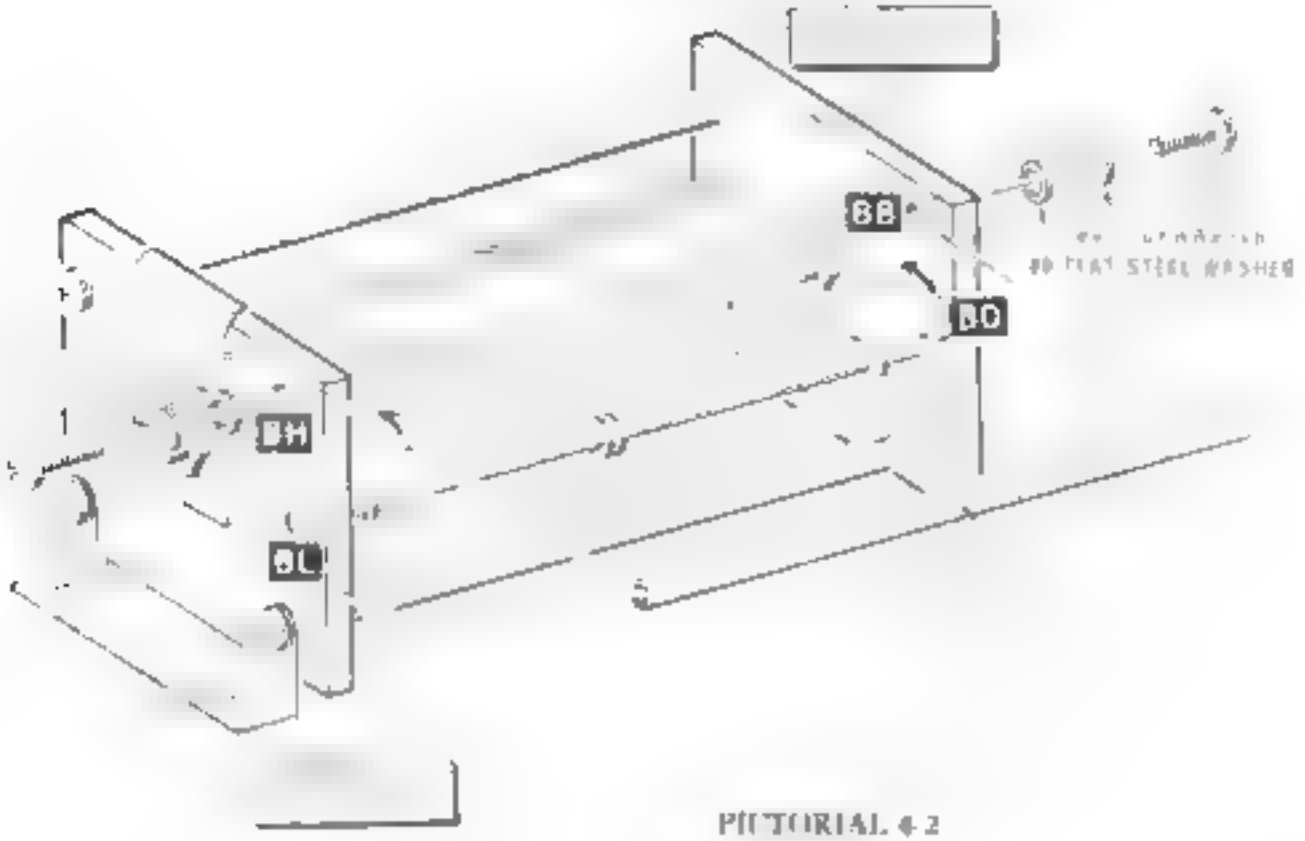
[ ] Start the bushing in the rear inductor end plate (noted and arrow) onto the rear shaft of the roller inductor. Be sure to position the end plate as shown in the Pictorial.

[ ] Line up hole BG with the spacer coming from hole BA of the front end plate. Then mount the rear inductor end plate to the spacer. Use an 8-32 × 5/8" screw, a #8 lockwasher and a #8 flat steel washer. Tighten the screw only finger tight.

[ ] Mount a capacitor mounting bracket to the rear inductor end plate and the remaining spacers at BM and BN. Use two 8-32 × 5/8" screws, two #8 lockwashers, and two #8 flat steel washers. Tighten these screws only finger tight.



Detail 4-1C



PICTORIAL 4-2

Refer to Pictorial 4-2 for the following step.

Slide the roller contact onto the tension rod. Then slide a #6 flat steel washer onto each end of the tension rod.

1. Start one end of the prepared tension rod into hole BB in the front inductor end plate.

   Start the free end of the tension rod into hole RL in the rear inductor end plate. Be sure the groove in the roller contact rests on one of the wire turns of the inductor.

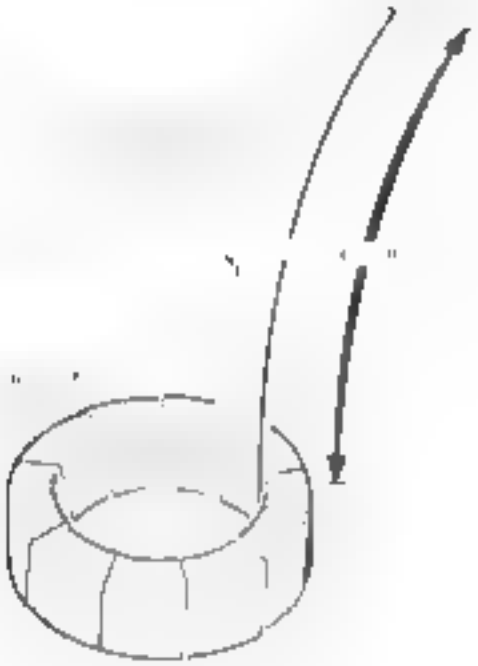
2. Position the two contactor springs toward the ends of the tension rod. Be sure the #6 flat steel washers on the tension rod are on the sides of the contactor springs away from the end plates.

3. Push an 8-32 x 8-5/16" tapped spacer between the front and rear inductor end plates. Be sure the contactor springs are inside the spacer as shown. Then mount the spacer at BB and RL. Use two 8-32 x 5/8" screws, two #8 lock washers, and two #8 flat steel washers. Tighten the screws only finger tight.

4. Set the roller inductor assembly on a flat surface. Then tighten the four screws on each inductor end plate.

   Push the inductor against the bushing in the front inductor end plate. Then push the collar on the rear inductor shaft firmly toward the rear inductor end plate and tighten the setscrew.

This completes the assembly of the roller inductor. Set the roller inductor aside until it is called for in a step.



PICTORIAL 5-1

BALUN COIL (T1)

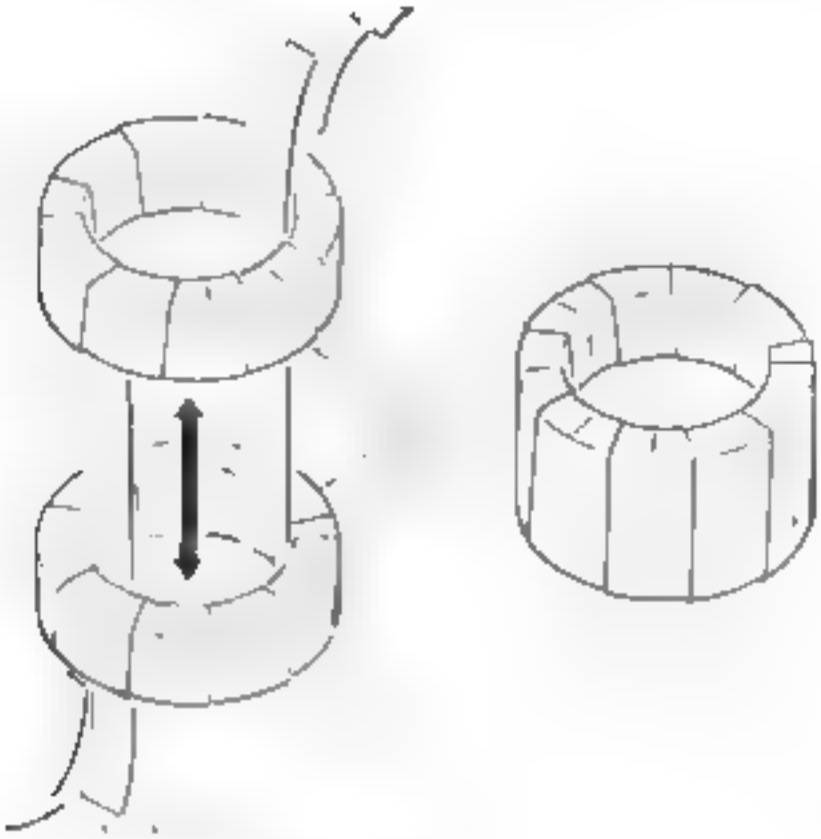
Refer to Pictorial 5-1 for the following steps.

NOTE: In the following steps, be careful, as the adhesive on one side of the tape does not stick to itself when you handle the tape.

[ ] Cut a 36" length off the roll of glass-cloth tape.

[ ] Wrap this length of tape around one toroid core to cover it completely with one layer. As you wrap the tape around the core, make sure you pull the tape snug. Make sure each turn overlaps the previous turn about 1/4". When you have covered the whole core with tape, you should have 8-10" remaining. Do not cut the tape off.

[ ] Similarly, use another 36" length of tape to cover the remaining toroid core with one layer of tape.



PICTORIAL 5-2

Refer to Pictorial 5-2 for the following steps

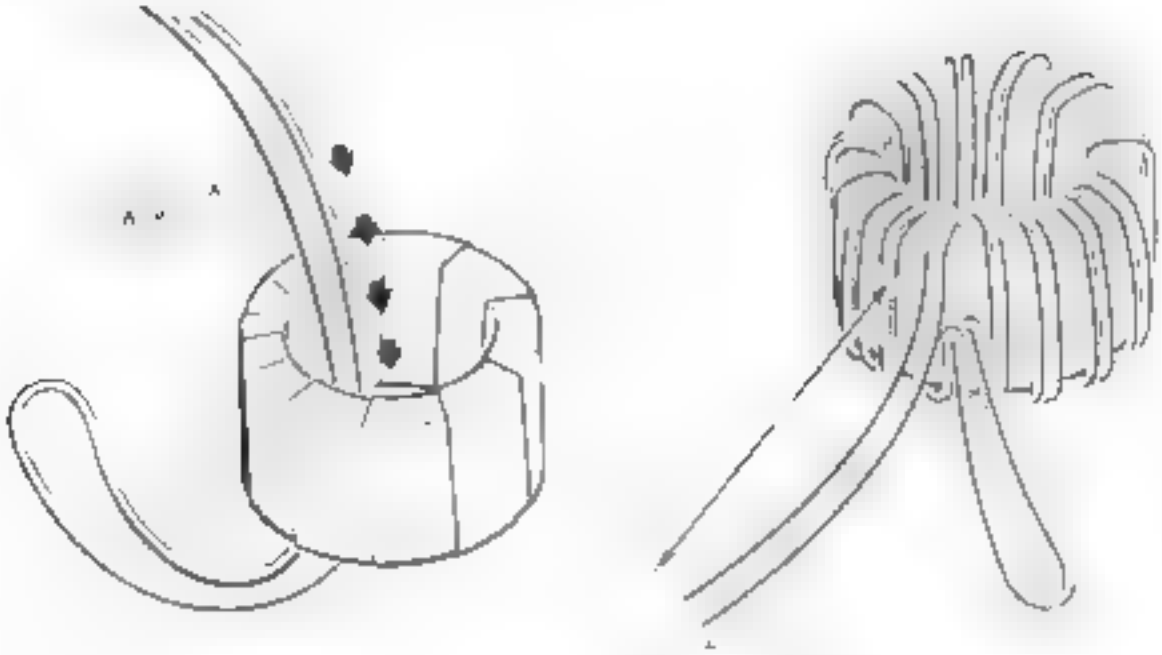
1. Hold one pretaped core between the thumb and index finger on your left hand. Then grasp the remaining pretaped core with your right hand. Slip the free end of the tape down through the center of the first core and place the cores on top of each other as shown.

2. Position the pretaped cores so the tape ends are located opposite each other. Then while you hold both cores in place firmly wrap the whole length of each tape around both cores. As before, make sure each turn overlaps the previous turn about 1/4".

3. Cut two 15" lengths of glass-cloth tape.

4. Wrap one of the tape lengths around the stacked cores at one of the two areas not previously covered with tape. Make sure you wrap the tape so it will overlap part of the tape ends already wrapped around the cores. If necessary, cut off any excess tape length.

5. Similarly wrap the other 15" length of tape around the cores at the area opposite the one covered in the last step. If necessary, cut off any excess tape.



PICTORIAL 5-3

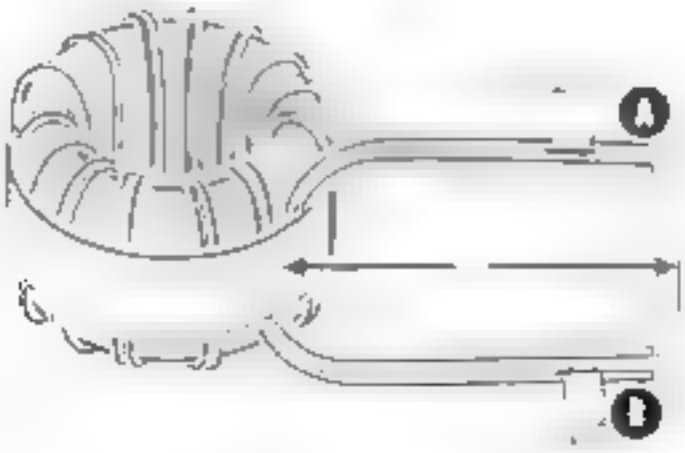
Refer to Pictorial 5-3 for the following steps.

- Locate the Teflon-insulated wire and cut it to a length of 11 feet.

NOTE: When you perform the next two steps, be sure to pull each winding until it is snug. An easy way to do this is to hook the folded end of the wire around a [illegible] then pull the wire until it is tight.

- Bend the 5-foot wire in the middle. Then push the folded end through the center of the dual core assembly. Adjust the two free wires until you have a length of about 6" from the [illegible] ends. Pull the wires firmly against the cores.

- Continue to loop the folded end of the wire around the core assembly through the center of it, until you have a total of 11 to 15 turns wound on the cores. Make sure you pull the wires snug for each turn you wind. Make sure the wires do not twist or overlap the other wires.



PICTORIAL 5-4

Refer to Pictorial 5-4 for the following steps.

Cut a 2-foot length of plastic cloth tape.

Thread the wire ends of the balun assembly as shown. Make sure the first and the last turns of the winding are pushed firmly down against the cores. Then start to wrap the 2-foot length of tape around the outer circumference of the assembly to hold these turns in place. As you wrap the tape onto the assembly, position each pair of wires so they are about evenly spaced all the way around the assembly. Wrap the entire 2-foot length of tape onto the assembly.

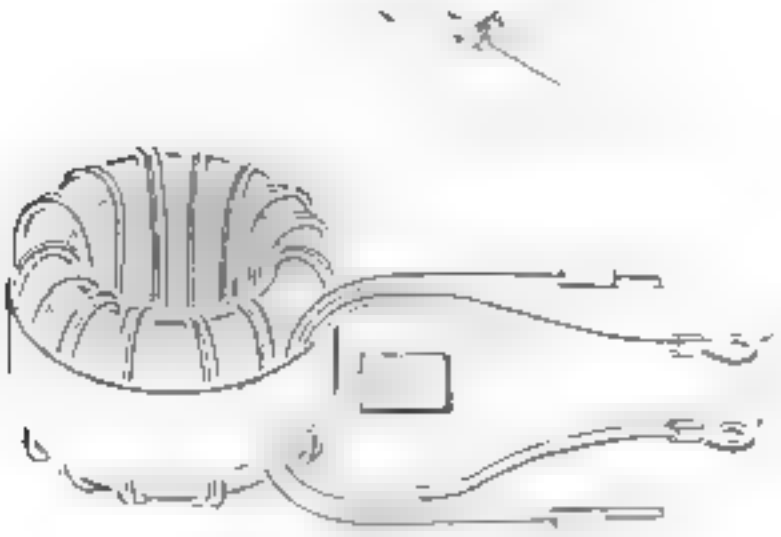
Cut the wire ends to the dimensions shown in the Pictorial and remove 1/4" of insulation from each wire end. Then twist the strands on each wire together and melt a small amount of solder on the wire ends to hold the strands together.

NOTE: The balun coil consists of two separate windings. When you install the balun and wire and form each winding will be connected to the chassis. Complete the next three steps carefully to make sure you select the proper wire ends.

[ ] At end A of the balun, wrap a 1" piece of tape around one of the two wire ends.

[ ] Turn on your ohmmeter and set it to the R x 1 range.

[ ] Connect one of the test leads to the wire with tape around it. Then connect the other test lead to one of the wires at end B of the balun. Wrap a 1" length of tape around this wire and that does NOT show continuity.



PICTORIAL 5-5

Refer to Pictorial 5-5 for the following steps.

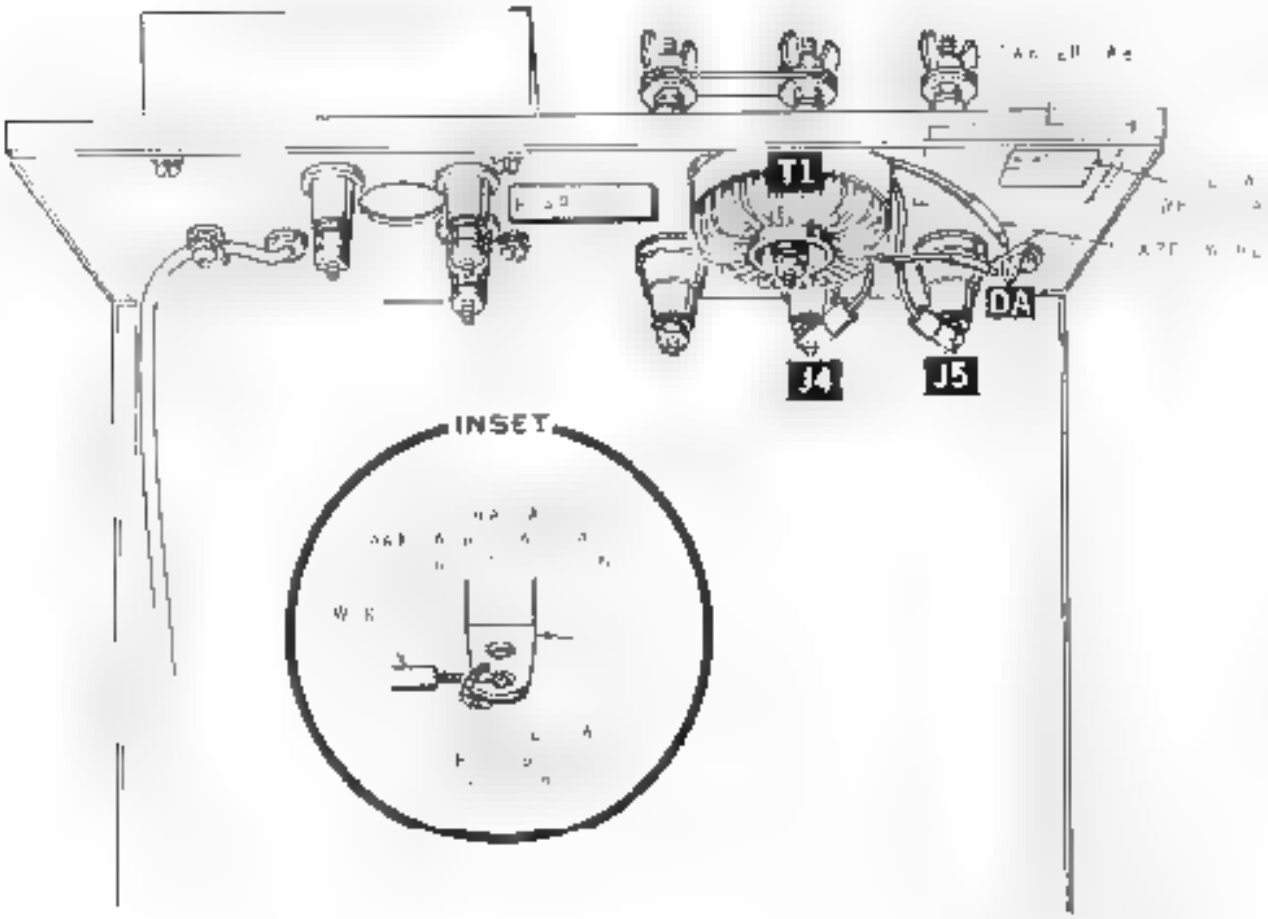
( ) Refer to Detail 5-5A Part A and use a pair of pliers to squeeze the sides of a #10 solder lug (only enough to compress the inner sleeve). Then turn the solder lug 90° as shown in Part B and squeeze it again until you can easily remove the metal sleeve from the solder lug (see Part C). Discard the metal sleeve (it will not be used).

( ) In the same manner, remove and discard the metal sleeve from one more #10 solder lug.

( ) Insert the bare end of one of the **untaped** balun coil wires into a #10 solder lug as shown. Crimp the tabs of the solder lug tightly against the wire. Then solder the connection.

( ) In the same manner, install a #10 solder lug on the remaining **untaped** balun coil wire.

Detail 5-5A



PICTORIAL 8-1

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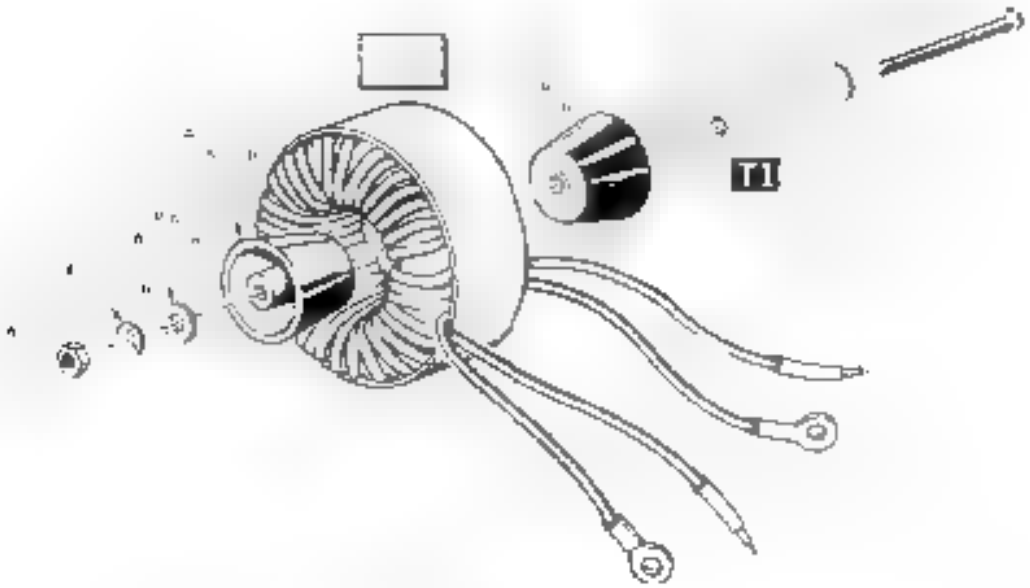


Detail 6-1A

CHASSIS FINAL ASSEMBLY

Refer to Pictorial 6-1 for the following steps.

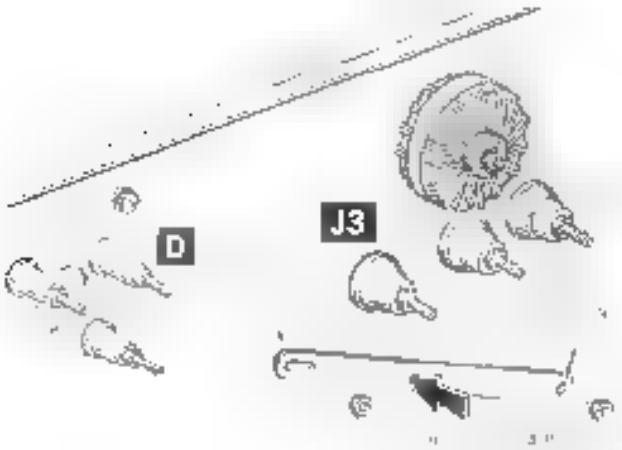
T1 Refer to Detail 6-1A and mount the balun coil on the rear panel at T1 as follows. Place a #6 brass washer on a 6-32 x 2" brass screw then start the screw through rear panel hole T1. Place a tapered spacer on the screw and position the center of the balun coil over the spacer as shown. Place another tapered spacer on the screw tapered end pointing inward. Secure the assembly with a #6 brass washer, a #6 lockwasher and a 6-32 nut. Position coil T1 as shown in the Pictures.

Place the solder lug at the end of the uninsulated balun coil wires and feedthrough hole as you removed in the last step. Tighten the nut snugly.

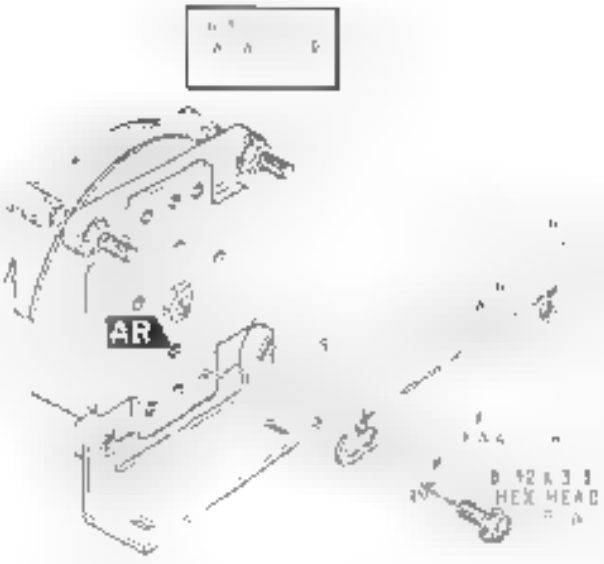
In the same manner, connect the remaining balun wire onto feedthrough lug. Tighten the nut snugly.

Push all four balun coil wires back against the inside of the rear panel.

Remove the paper backing from the rear panel white label and press the label in place on the inside of the rear panel in the upper right corner as shown. NOTE: Be sure to refer to the model



Detail 6-2A



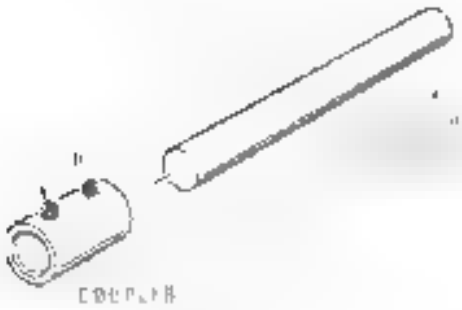
Detail 6-2B

Refer to Detail 6-2A and temporarily remove the nut and strain relief from feedthrough J3. Then slide the **round hole** end of a 4-19-32" strap (supplied with the kit) over the stud. Tighten the nut only finger-tight at this time.

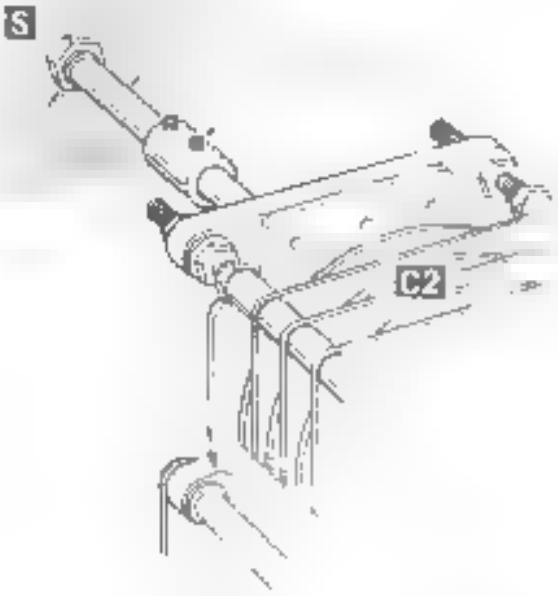
Refer again to Detail 6-2A and remove the nut from feedthrough D and place the free end of the 4-19-32" strap over the stud. Reinstall the nut on the feedthrough and tighten it finger-tight.

Push the 4-19-32" strap toward the rear of the chassis as shown in Detail 6-2A. Then tighten the nuts on feedthroughs D and J3.

Refer to Detail 6-2B and on the rear mounting plate of rear loop capacitor C2, mount the **slotted hole** of a 7-13-16" strap at hole AR (as shown below the ground solder lug). Use a 6-32 x 3/8" hex head screw and a #6 lockwasher. Tighten the screw only finger-tight. Position the strap as shown in the Detail.



Detail 6-20



Detail 6-21

[illegible] extension shaft using a shaft coupler.

[illegible] a small amount of grease to each tuner extension shaft as shown.

[illegible] tuner shaft into front panel bushing S. Then position machine capacitor C2 into the [illegible]

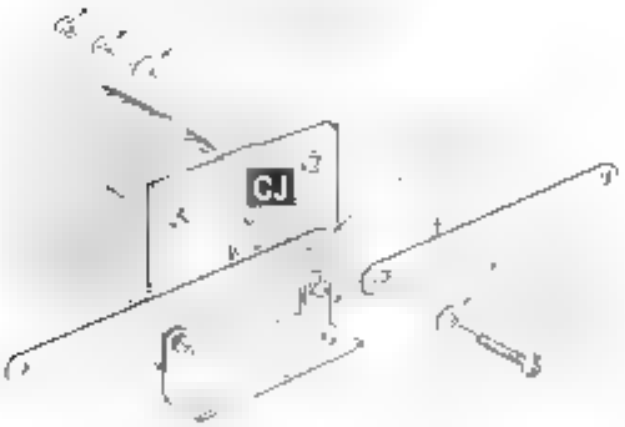
[illegible] Refer to panel drawing #2 and [illegible] as shown.

[illegible] knobs on the chassis with a #[illegible] screw with [illegible]

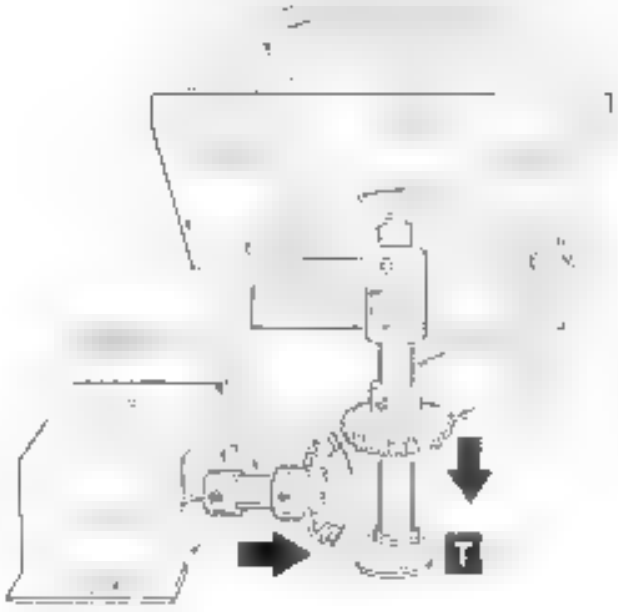
[illegible] Push capacitor C2 as far forward as it [illegible] C2 is near [illegible]

[illegible] gives

[illegible] m tuning screw at C2 hole AR



Detail 6-3A



Detail 6-3B

Refer to Photo 6-3 (centerfold Page 11) for the following steps.

( ) Push a shaft coupler halfway onto the metal extension shaft. Tighten the setscrew onto the shaft.

( ) Place a nylon gear onto the end of the shaft as shown. Do not tighten the gear setscrew.

( ) Apply some grease on the metal extension shaft about 1" from the end. Then from the rear of the front panel, push the shaft through bushing T.

( ) Refer to Detail 6-3A and on the rear of the chassis, loosely secure the slotted ends of two 4-10/32" straps at CJ as shown (Use a 6-32 x 3/4" brass screw, two #6 brass washers, a #6 lockwasher and a 6-32 nut). Tighten the hardware finger tight. Position the straps as shown in the Pictorial.

( ) Position the roller inductor into the chassis and slide it forward as far into the shaft coupler as it will go, then tighten the coupler setscrew onto the shaft.

( ) Slide the rod for rearward and line up the mounting holes with those in the chassis. Hold the inductor in place. Refer to Detail 6-3B and loosen the setscrew in the counter shaft stepped coupler. As you slide the stepped coupler to meet the inductor shaft, slide the gear on the inductor shaft forward until the two gears are equally meshed. Tighten the setscrew in the stepped coupler.

( ) Slide the nylon gear rearward on the inductor shaft. Then as you view the inductor from the shaft end, turn the inductor counterclockwise until the inductor rotor hits the rear stop.

( ) Mount the roller inductor into the chassis at CK, CF, CE and CH with 6-32 x 3/8" hardware as shown in the inset drawing on Pictorial 6-3. After all the hardware is installed finger tight, push the inductor as far forward as possible, then tighten the mounting hardware.

( ) Tighten front panel bushing T.

( ) Turn the inductor gear if necessary until the inductor rotor is at the "0.0.0" mark. Make sure the inductor is turned fully counterclockwise. Then slide the nylon gear on the inductor shaft forward until it meshes with the counter gear. Tighten the setscrew onto the inductor shaft.

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Detail 6-4A

On the rear of [illegible] L1 position one of [illegible] coming from C1 onto capacitor C[illegible] [illegible] shaft AN. Secure the strap at AN with a [illegible] nut. Do not tighten the strap on the [illegible].

Refer to Pictorial 6-4 (Illustration Booklet, Page 12) for [illegible]

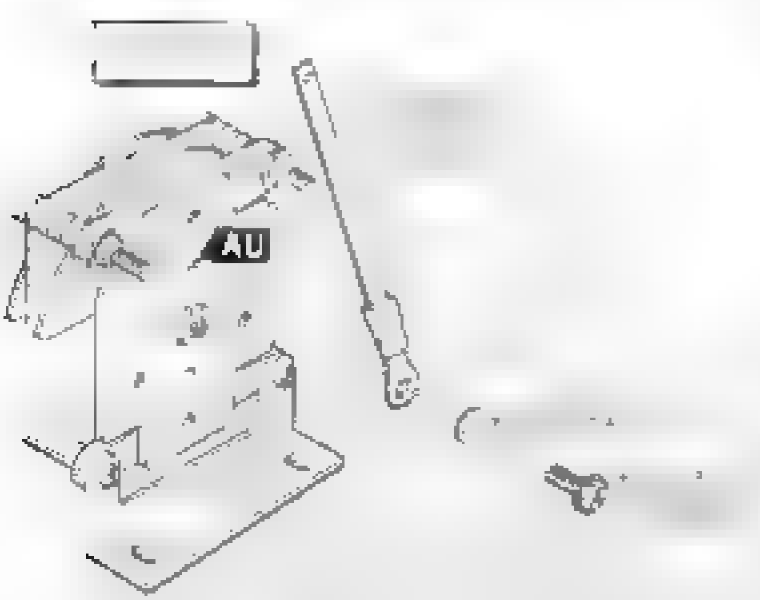
( ) Locate the narrow 6" strap and cut the strap in half. Refer to Detail 6-4A and, with heavy pliers, flatten the upper end of the remaining #10 solder lug as shown. Cut a taper on the corners of one of the 3" straps, then form the solder lug around the tapered end of the 3" [illegible] as shown. As you sol[illegible] strap to the lug, be sure the solder completely penetrates through the solder lug.

( ) Refer to Detail 6-4B and connect the solder lug on the 3" strap to hole AL in the rear mounting plate of capacitor C1 using a 6-32 × 3/8" hex head screw and a #6 lockwasher. Tighten the [illegible]

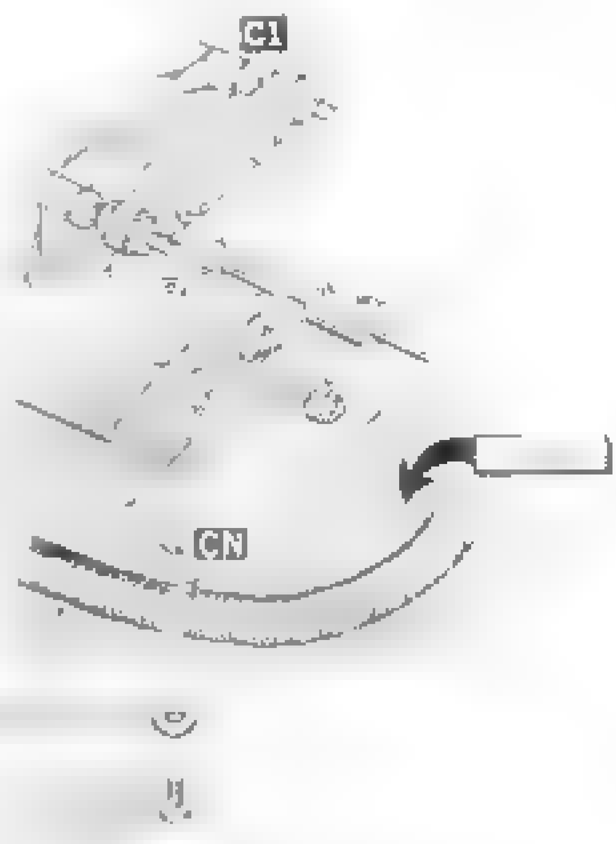
[illegible] the [illegible] shaft [illegible] into front panel bushing X. The [illegible] the end of the shaft [illegible] fully seated. Tighten [illegible]

[illegible] CL with a 6-32 × 3/8" black screw, two #6 brass washers, a #6 lockwasher, and a 6-32 nut at each hole as shown in the [illegible] on Pictorial 6-4. Tighten the hardware finger tight.

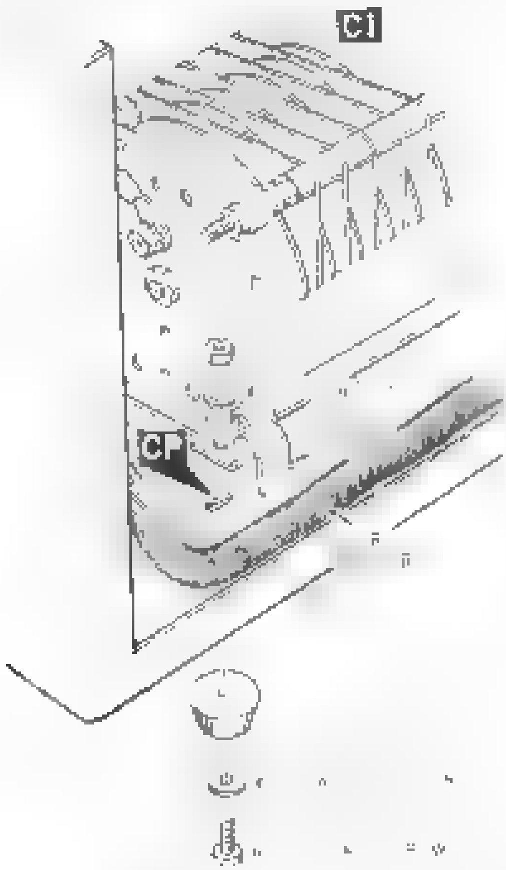
Refer to Detail 6-4C and at CN [illegible] capacitor to the chassis with a 6-32 × 3/8" black screw, a #6 brass washer, [illegible], a #6 lockwasher, and a 6-32 nut. Place the cable shield under the cable clamp [illegible] in the clamp as shown [illegible] Pictorial. Tighten the hardware finger tight.



Detail 6-4B



Detail 6-4C



Detail 8-4[illegible]

( ) Refer to Detail 8-4L and [illegible] a [illegible] [illegible] strap, a #6 lock-[illegible] at Position [illegible] cable [illegible] clamp as [illegible] [illegible] tight.

( ) Push capacitor C[illegible] as far forward as possible then tighten the mounting hardware at CK, CL, CN and [illegible].

IMPORTANT: Be sure the spiral shield is positioned away from tuning capacitor C1 as shown in Pictorial 8-4.

( ) Tighten front panel shaft bushing X.

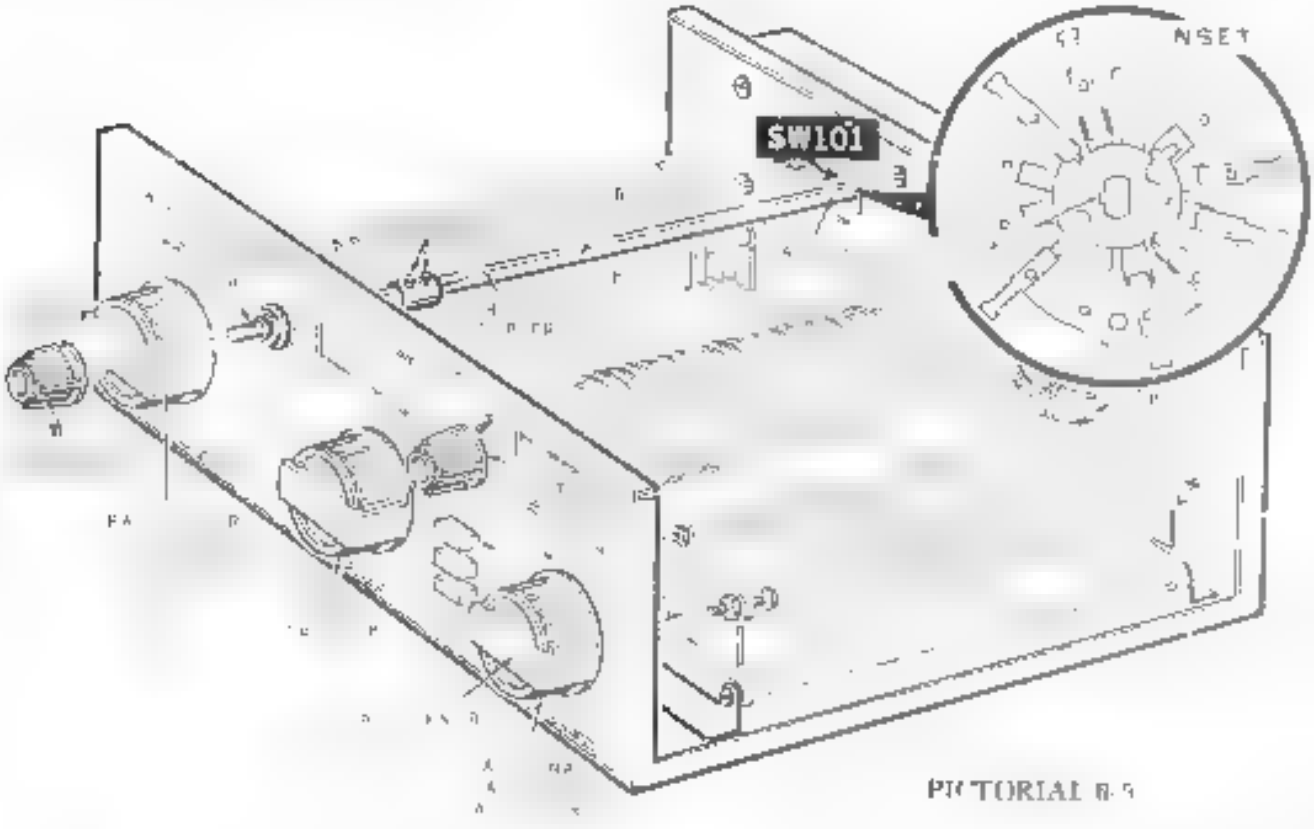
( ) Remove the nut from the end of feedthrough stud B and place the hole in the end of the strap coming from capacitor C1 hole AB over the stud. Tighten the nut onto the stud.

( ) Tighten capacitor strap screw AL.

( ) Position the end of the remaining strap coming from the rear of inductor L1 onto the threaded spacer at AT on capacitor C1. Secure the strap with a 10-32 brass nut.

( ) At the rear of roller inductor L1, hook your middle and index fingers over the two straps going to matching capacitors C1 and C2. As you pull firmly rearward on the straps, tighten the strap mounting screw at CJ. If necessary, after the screw is tight, reform the straps slightly to make sure they are as far as possible from the inductor spacer screws at the upper corners.

( ) [illegible] the straps [illegible] of the chassis. Make sure they do not touch each other or any metal parts other than those that they are connected to. Reform the straps as [illegible].



PICTORIAL 6-5

Refer to Pictorial 6-5 for the following steps.

Turn the detent shaft fully counterclockwise (as viewed from the front panel). This may not already been done.

( ) Refer to the inset drawing on the Pictorial and be sure SW101 rotor is positioned exactly as shown. **Do not turn the switch** until the coupler has been secured on the detent.

( ) Place a shaft coupler onto the flatted end of the detent shaft. Slide the coupler so it is all the way past the end of the shaft.

( ) Position the fiber shaft flatted end through the large hole in the rear panel and into the center of switch SW101 in the remote sensor assembly. Align the front end of the shaft with the detent shaft and slide the shaft coupler forward so half the coupler is on each of the two shafts. Tighten both coupler setscrews.

( ) Grasp the shaft coupler and turn the shaft to the second of the four switch positions.

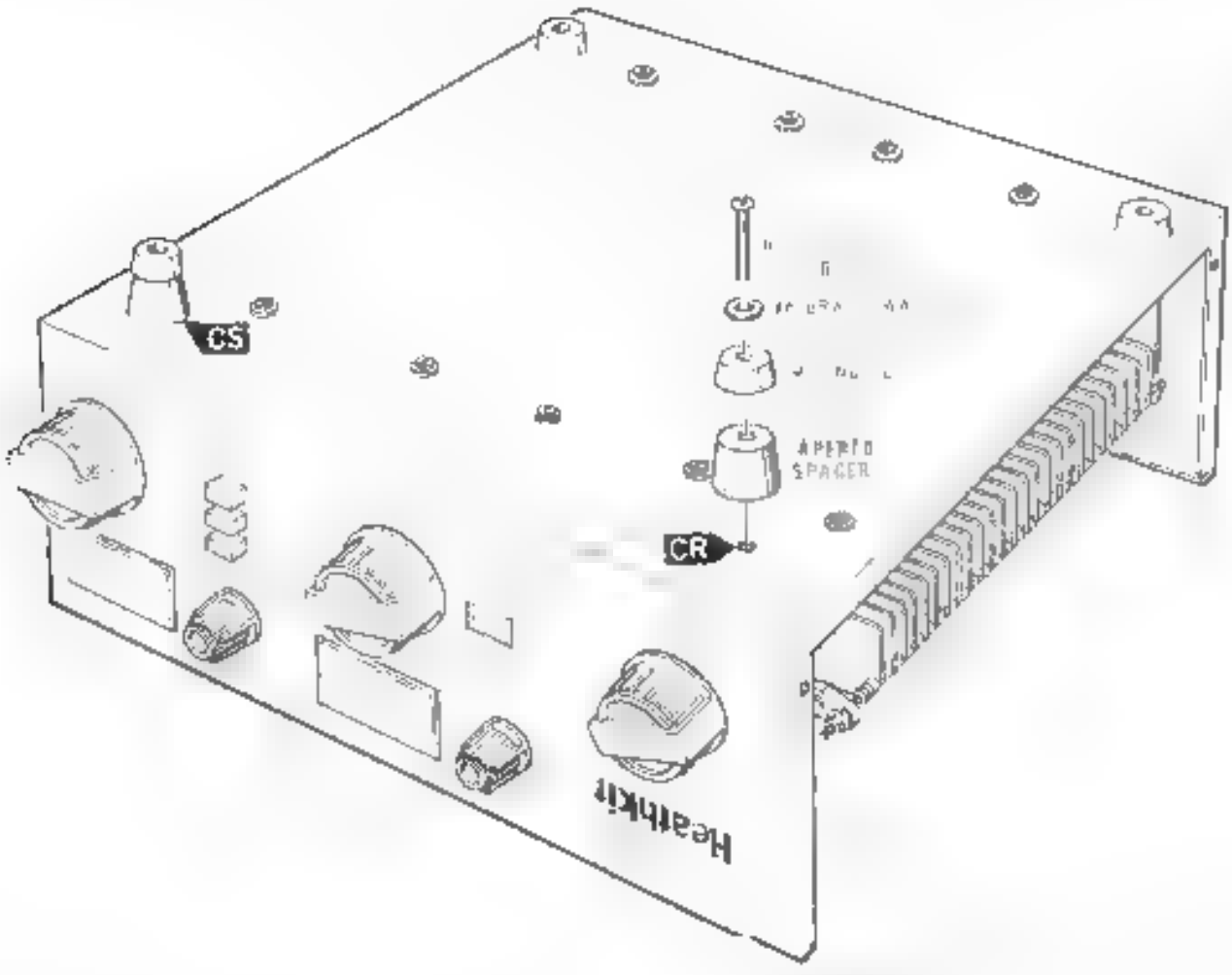
Turn a 6-32 x 1/8" setscrew into a small knob as shown. Place the knob onto the detent shaft at the upper left of the front panel. Position the knob pointer directly at "COAX 1". Then tighten the setscrew.

Turn the SENSITIVITY control fully counterclockwise. Start another 6-32 x 1/8" setscrew into a small knob. Place the knob on the SENSITIVITY control shaft and turn the knob pointer to the 7-o'clock position. Tighten the setscrew.

Place a large knob on the INPUT TUNE shaft and tighten the setscrew.

Turn the rotors of both variable capacitors fully meshed (maximum capacity). Then place a large knob on the shaft of TRANSMITTER MATCHING capacitor C1. Position the knob pointer at "1:30" and tighten the two knob setscrews.

In the same manner, install the remaining large knob on the shaft of ANTENNA MATCHING



Refer to Pictorial 6-6 for the following steps.

1 Position the chassis as shown in the Pictorial.

NOTE: Perform only one of the next two steps.

1 If you wish to have your Antenna Tuner for the lowest frequency only round foot at CR and CS on the bottom of the chassis, use two 6-32 x 3/8" screws, #6 lockwashers and 6-32 nuts.

1 2 If you wish to have the front of the chassis [illegible] stations at CR and CS on the bottom of the [illegible] #6 lockwashers and two 6-32 nuts.

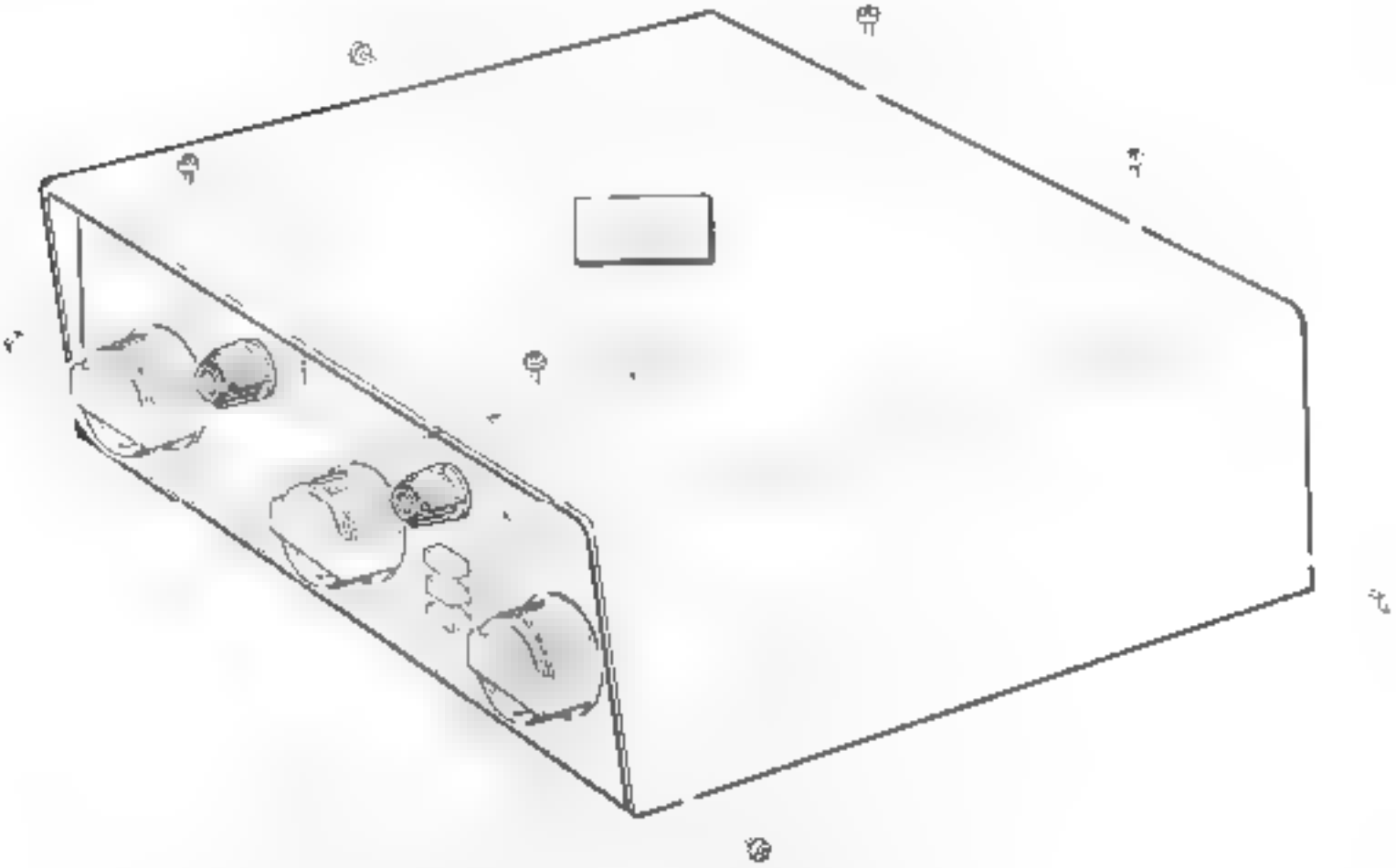
PICTORIAL 6-6

[illegible] assembly of your Antenna Tuner. Refer to the following [illegible] to "Final Assembly."

Make sure all [illegible]

4 Make sure [illegible] Note.

FINAL ASSEMBLY



PICTORIAL 7-1

APPLICATIONS AND INSTALLATION

Refer to Pictorial 8-1 (Illustration Booklet Page 13) for the following steps

1. Check RFF meter M1 to see that the pointer is centered over the left index. If it is not, turn the Meter Adj screw just below the front panel meter cut out slightly in either direction until the pointer is correctly positioned.

2. In the same manner, if necessary, adjust the pointer position of FWD meter M2 so its pointer is directly over the left index.

APPLICATIONS

This Antenna Tuner will convert a reactive and/or resistive load to a nonreactive, 50-ohm load. You can adjust it to tune out load reactance and transform the load impedance to the required 50-ohm transmitter (or amplifier) output impedance. The Tuner uses a roller inductor along with two variable capacitors to provide an almost unlimited matching range, and features 160-meter through 10-meter coverage without band switching.

A 4-to-1 (balanced-to-unbalanced) balun coil on the output side of the Antenna Tuner permits the use of balanced feed lines. You can use the Tuner to match into coaxial lines, random-length end-fed wires, or balanced feeders.

INSTALLATION

Pictorial 8-2 (Illustration Booklet, Page 13) shows a typical fixed-station installation. This Pictorial shows an installation where the Antenna Tuner's internal coaxial switch (SW101) may be used to feed the RF source either to your Antenna Tuner or any one of several 50-ohm antennas or RF loads. If an amplifier is not used, connect the cable from the transmitter's antenna connector directly to the RF input jack on the rear panel of the Antenna Tuner.

Use the coaxial cable (like RG-8/U) to interconnect the various pieces of equipment. NOTE: Cables should not be longer than necessary.

A ground post is located on the rear panel of the Antenna Tuner. Connect this ground post to a good earth ground or a water pipe. **Use the shortest and heaviest connection possible.**

Before you use a water pipe ground, inspect the connection around your water meter. Make sure that no plastic or rubber hose connections are used which interrupt electrical continuity to the water supply line. Install a jumper around any insulating water connections you find. Use heavy copper wire and pipe clamps. It is best to ground all equipment to one point at the operating position; then ground this point to the water pipe.

Refer to various publications, such as the ARRL Radio Amateur Handbook, for more information concerning grounds.

OPERATION

Refer to Pictoria, 8-3 Illustration Booklet, Page 14 to identify the front panel meters, switches, controls and the counter readout. A description of the function of each is included. Also, refer to Pictorial 8-2 for any rear panel connections.

EXCITER TUNE-UP

The final stage of some transmitters must be tuned up before they can be placed on the air. **It is important that you tune up an exciter on a "dummy load" before you use it with your Antenna Tuner.** You can use any load that has a constant, resistive impedance of 50 ohms that can dissipate the necessary power for a reasonable length of time. As an example, the Heathkit "Cantenna" is a satisfactory load. NOTE: **Do not** use light bulbs as a "dummy load." Their resistance varies with the current, and their reactance varies with frequency.

COUPLER TUNING

NOTE: When you turn the roller inductor, be careful that you do not turn it past its end stops. This could cause the roller contact to jump off the wire turns on the inductor.

This part of the "Operation" section includes the procedure for using your Antenna Tuner with various antenna systems. The "Preset Chart" on Page 62 gives the approximate settings for the Antenna Tuner controls when a 50 Ω resistive RF dummy load is used. Be sure to record the settings of both variable coupler knobs and the counter so you can preset the controls the next time you use a particular band. For your convenience, two "Logging Charts" are included on Pages 60 and 61 of this Manual. You may wish to make several copies of these Charts for use in the future.

NOTE: The "ARRL Antenna Book" is readily available and includes comprehensive information on transmission lines and antennas. You can purchase it at your local radio amateur handbooks and some are available in public libraries.

Before you proceed, make sure you connect your transmitting equipment as shown in Pictorial 8-2. NOTE: If you are not using an amplifier, connect the coaxial cable from the exciter's RF output connector directly to input connector J3 on the rear panel of the Antenna Tuner.

IMPORTANT

1. During the tuning procedure, apply only enough RF power from the exciter to get a meaningful reading on REF meter M1 in its most sensitive position. When you have made coarse adjustments to the Antenna Tuner as for a low or minimum reflected power, you may increase the power from the exciter. At this time you can make final adjustments to the Antenna Tuner.

2. When you tune your exciter, be sure to observe the duty cycle limitations, if any.

3. Many solid-state exciters have automatic VSWR shut-down circuits. During the following tuning procedures, a decrease in VSWR should correspond to an increase in forward power.

Coaxial-Fed Antennas

An antenna fed with a coaxial line, such as a beam antenna or a simplified dipole, can usually be matched with your Antenna Tuner to provide a good match to the transmitter across the entire band. This will be particularly beneficial when, for example, you use an 80-meter dipole that has been cut for a particular portion of the band.

For coax-to-coax feeder matching, use the following tuning procedure:

1. Preset your Antenna Tuner controls as follows:

   TRANSMITTER MATCHING (C1)
   INDUCTOR (L1)
   ANTENNA MATCHING (C2)

   } Refer to the "Preset Chart" on Page 52 for approximate settings.

2. Connect the antenna feed line to COAX 1 connector J1 or to COAX 2 connector J2, or to BYPASS jack J7 for a 50-ohm, nonreactive (dummy load) on the rear panel of the Antenna Tuner. NOTE: When you use BYPASS jack J7, the meters will still indicate, but the matching circuits will not have any effect.

3. Set antenna switch SW101 to the position of the connector you selected in Step 2.

4. Set FWD-SET switch SW1 to the FWD (up) position to measure the forward power on FWD meter M2.

5. Set HIGH-LOW switch SW3 to LOW (in).

6. Set REF SWR switch SW2 to SWR (in).

7. Set SENSITIVITY control R3 to the most sensitive position (fully clockwise).

8. Turn the exciter power on.

9. With the exciter in either the tune or CW mode, advance the exciter's carrier level (or power output) control for an on-scale reading on REF meter M1.

10. Adjust L1, the roller inductor, until there is a drop in the SWR reading on REF meter M1.

11. Readjust capacitors C1 and C2, along with inductor L1, until you obtain the lowest SWR reading on REF meter M1.

NOTE: With many antenna systems, you can obtain several different matching combinations. **Always use the matching setting that uses the most capacitance for C1 and C2, as maximum capacitance provides the best harmonic attenuation.** Maximum capacitance occurs when C1 and C2 are set to 100.

12. Advance the exciter's carrier level (power output) for full power output. Then readjust C1, C2, and L1 for minimum reflected power. Adjust the SENSITIVITY control counterclockwise as necessary. NOTE: If the FWD meter indicates more than 200 watts, release HIGH-LOW switch SW3 to HIGH.

This completes the tuning procedure for coax-fed antennas. You can now use an amplifier without retuning the Antenna Tuner.

Single-Wire Antennas

NOTE: If possible, use an end-fed quarter wavelength antenna or an odd multiple of a quarter wavelength. Such an antenna will have low impedance and will reduce the chances of high RF voltages appearing on the Antenna Tuner or associated equipment.

For end-fed wires, random length wires or Windom type antennas, use the following tuning procedure:

1. Preset your Antenna Tuner controls as follows:

   TRANSMITTER MATCHING (C1)
   INDUCTOR (L1)
   ANTENNA MATCHING (C2)

   } Refer to the "Preset Chart" on Page 52 for approximate settings.

2. Connect the antenna to SINGLE WIRE connector J3 on the Antenna Tuner rear panel. Be sure the shorting bar is not connected to connector J3.

3. Turn antenna switch SW101 to the SINGLE WIRE position.

4. Set FWD-SET switch SW1 to the FWD (out) position to measure forward power on FWD meter M2.

5. Set HIGH-LOW switch SW3 to LOW (in).

6. Set REF-SWR switch SW2 to SWR (in).

7. Set SENSITIVITY control R3 to the most sensitive position (fully clockwise).

8. Turn the exciter power on.

9. With the exciter in either the tune or CW mode, advance the exciter's carrier level or power output) control for an on-scale reading on the REF meter M1.

10. Adjust L1, the roller inductor, until there is a drop in the reflected reading on meter M1.

11. Read-just capacitors C1 and C2, along with inductor L1, until the lowest SWR reading is obtained on REF meter M1.

NOTE: With many antenna systems, you can obtain several different matching combinations. **Always use the matching setting that uses the most capacitance for C1 and C2, as maximum capacitance provides the best harmonic attenuation.** Maximum capacitance occurs when C1 and C2 are set to 100.

12. Advance the exciter's carrier level (power output) control for full power. Then read-just C1, C2, and L1 for minimum reflected power. NOTE: If the FWD meter indicates more than 200 watts, release HIGH-LOW switch SW3 to HIGH.

This completes the tuning procedure for single-wire antennas. You can now use an amplifier without retuning the Antenna Tuner.

Balanced Feed Line Antennas

For antennas using balanced feeders, use the following tune-up procedure.

1. Preset your Antenna Tuner controls as follows:

   TRANSMITTER MATCHING (C1) }
   INDUCTOR (L1) } Refer to the "Preset Chart" on Page 6-5 for approximate settings.
   ANTENNA MATCHING (C2) }

2. Connect the shorting bar between connectors J3 and J4 on the rear panel of the Antenna Tuner.

NOTE: When the shorting bar is connected between connectors J3 and J4, RF power is present on J3 and J4. Therefore, if you have a single-wire antenna connected to J3 and a balanced or unbalanced feed line connected to J4 and J5, RF power will be simultaneously applied to two antennas.

3. Turn the antenna switch SW1 to the LONG WIRE position.

4. Connect the antenna feed line to BALANCED FEED LINE connectors J4 and J5.

5. Set HIGH-LOW switch SW3 to LOW (in).

6. Set REF-SWR switch SW2 to SWR (in).

7. Set the FWD-SET switch to FWD (out) to measure forward power on meter M2.

8. Set SENSITIVITY control R3 to the most sensitive position (fully clockwise).

9. Turn the exciter power on.

10. With the exciter in either the tune or CW mode, advance the exciter's carrier level or power output) control for an on-scale reading on REF meter M1.

11. Adjust L1, the roller inductor, until there is a drop in the reading on REF meter M1.

12. Readjust capacitors C1 and C2, along with inductor L1, until you obtain the lowest SWR reading on REF meter M1.

NOTE: With many antenna systems, you can obtain several different matching combinations. **Always use the matching setting that uses the most capacitance for C1 and C2 as maximum capacitance provides the best harmonic attenuation.** Maximum power output occurs when C1 and C2 are set to full.

7. Advance the exciter's carrier level power output control for full power. Then rotate C1, C2, and L1 for minimum reflected power. Adjust the SENSITIVITY control counter clockwise as necessary. NOTE: If the FWD meter indicates more than 200 watts, release HIGH-LOW switch SW3 to LOW.

This completes the tuning procedure for balanced and single antennas. You can now use an amplifier without returning the Antenna Tuner.

SWR MEASUREMENTS

SWR measurements basically indicate to you the ratio of maximum voltage (or current) to minimum voltage (or current) along a transmission line and an antenna. To obtain an SWR indication on your REF meter:

Set your exciter to the desired frequency.

2. Perform the tuning procedure described under "Coupler Tuning" that corresponds to the antenna you are using.

3. Set FWD-SET switch SW1 to the FWD position (out).

4. Set HIGH-LOW switch SW2 to the correct power level.

   LOW (in) for 0-200 watts.
   HIGH (out) for 100-2000 watts.

5. Turn the exciter on and advance its RF output level for the desired forward power indication on FWD meter M2.

6. Set FWD-SET switch SW1 to the SET position (in).

7. Set REF-SWR switch SW2 to the SWR position (in).

8. Adjust SENSITIVITY control R1 so that the pointer of REF meter M1 points to the SET marking on the meter.

9. Set FWD-SET switch SW1 to the FWD position (out) and read the SWR on the SWR scale of REF meter M1. At this time, FWD meter M2 will indicate the forward power. NOTE: If the SWR is greater than 3:1, read the forward and reflected power levels. Then use these power levels and the SWR Chart on Page 55 to determine the SWR.

FORWARD POWER MEASUREMENT

Use the following procedure to determine the level of power that is being coupled to the antenna.

1. Set your exciter to the desired frequency.

2. Perform the tuning procedure described under "Coupler Tuning" that corresponds to the antenna you are using.

3. Set FWD-SET switch SW1 to the FWD position (out).

4. Set HIGH-LOW switch SW3 to the LOW position (in).

5. Turn the exciter on and advance the RF output level while you observe FWD meter M2. The meter will indicate the forward power on the 0-200 scale. If the meter indicates more than 200 watts, set HIGH-LOW switch SW3 to HIGH (out) and read the power on the 0-2000 power scale.

REFLECTED POWER MEASUREMENT

Use the following procedure to determine the level of power that is being reflected back towards the exciter due to a mismatch in the antenna system.

1. Set your exciter to the desired frequency.

2. Perform the tuning procedure described under "Coupler Tuning" that corresponds to the antenna you are using.

3. Set REF-SWR switch SW2 to the REF position (out).

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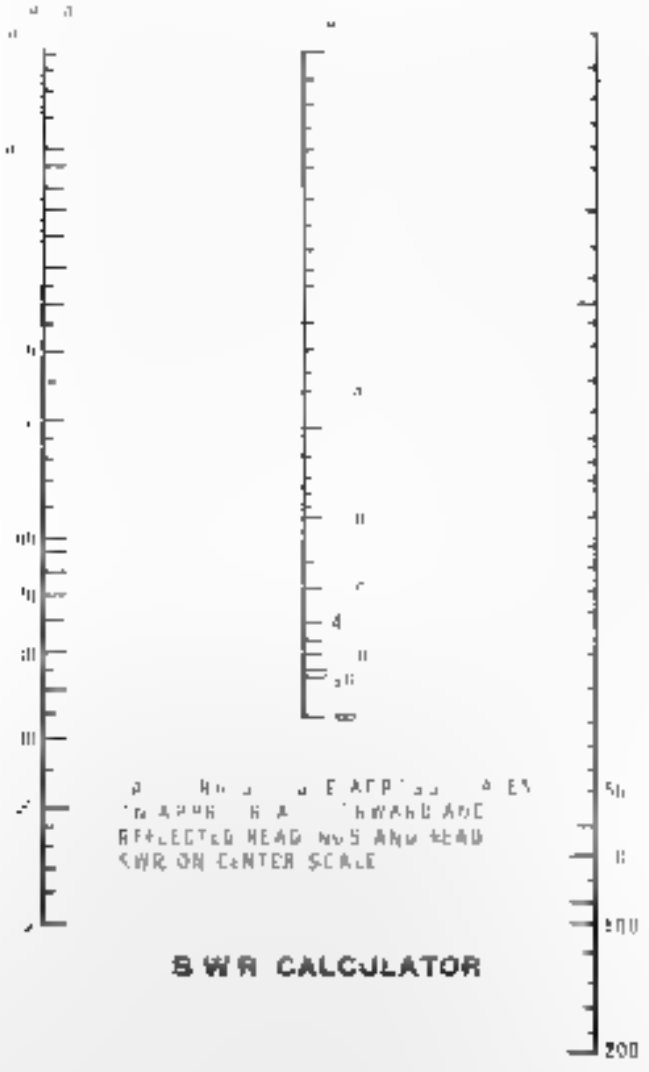
4 Set HIGH-LOW switch SW2 to the LOW position.

Turn the exciter on and advance the RF output level while you observe REF meter M. The REF meter will indicate the reflected power on the 0-50 scale. If the meter indicates more than 50 watts, set HIGH-LOW switch SW2 to HIGH (out) and read the power on the 0-500 power scale.

SWR CHART



PICTORIAL 9-1

TYPICAL OPERATING CHARACTERISTICS

- A severe mismatch may cause a transmitter to become unstable until the SWR is reduced to a low value (1.5:1 or less). This is especially true of broadband solid-state transmitters. However, this can also occur with tube-type tuned transmitters.

- You may find that you have no reflected power as indicated by your SWR meter at a number of settings of the roller inductor and the capacitors for some band antenna combinations. Always use the matching setting that uses the most capacitance for the variable capacitors.

IN CASE OF DIFFICULTY

If your Antenna Tuner does not operate properly, make the following checks:

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the kit builder.

2. About 90% of the kits that are returned to the Heath Company for service do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" instructions on Page 5.

3. Check each capacitor value. Make sure that a capacitor of the correct value is installed at each capacitor location.

4. Check each resistor value carefully. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial.

5. Be sure all the wires and leads have been trimmed as close as possible to their connecting points.

6. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

   The antenna you use should be insulated along its entire length from any contact with any parts of buildings, trees, etc. Keep the antenna as far as possible from all objects for maximum operation efficiency.

7. If for any reason the meters fail to register, check for the following conditions:

   a. Shorting wire(s) removed from the meter lugs.

   b. Sensitivity control connections correctly wired and well soldered.

   c. Sensor cable connections at switch SW3 all correctly wired and well soldered.

   d. Check to make sure that there is an RF input to the remote sensor, and that there is an output.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Customer Service information inside the rear cover of this Manual. The Warranty is located inside the front cover.

SPECIFICATIONS

Frequency Range continuous tuning	1.8 to 30 MHz.
Input Power Capability	
SSB	2000 watts (peak).
CW	1000 watts.
Input Impedance	50 ohms
Output Impedance	Wide range
Balanced to Unbalanced Transformation	4:1 balun
Meter Functions	Forward and Reflected average power and SWR
Meter Ranges	
Forward (2 ranges)	Low — 0-200 watts High 0-2000 watts
Reflected (3 scales)	Low 0-50 watts High 0-500 watts SWR 1:1 to 3:1
Wattmeter Accuracy (full scale)	
200 W and 2000 W (FWD), 500 W (REF)	±5% (AVG)
50 W (REF)	±7.5% (AVG).
Insertion SWR	Less than 1.5:1
Overall Dimensions	14-1/2" × 13-7/8" × 5-3/4" (36.8 × 35.2 × 14.5 cm).
Net Weight	15-1/2 lbs (7.1 kg).

CIRCUIT DESCRIPTION

Refer to the fold-in Schematic Diagram while you read this Circuit Description.

TUNER CIRCUIT

The Antenna Tuner is an adjustable RF transformer that will match an unknown load presented by an antenna and its feedline to the required 50-ohm transmitter impedance.

Coupling capacitor C2 modifies the load impedance fed back to the tuned circuit formed by capacitor C1 and inductor L1. The total resonant impedance across the tuned circuit depends on the L/C ratio of C1 and L1, and the load impedance as transformed by C2. Capacitor C1 performs capacitive tapping which results in a 50-ohm impedance at RF input connector J6.

The reactive loads at switched output connectors J1, J2, and J7 are compensated for as you adjust C1 and C2 for [illegible].

A 4:1 (balanced-to-unbalanced) balun coil, T1, is used for balanced line operation.

METER OPERATION

From input jack J6 on the sensor, the conductor is routed through toroid coil L101, through the contacts of coaxial switch SW101, and to either the bypass output at J7, or through the Tuner circuits to outputs J1, J2, or to the feedthrough single- or dual-line with outputs at J3, J4, and J5.

L101 is a current pickup element for both the forward and reflected power which passes through the sensor. A transmitted signal passing through the sensor induces a voltage in the toroid coil. This voltage is directly proportional to the amount of RF current. A voltage sampled directly from the transmission line is summed with the voltage at L101. The sum of the voltages is then rectified by diode D102 and filtered by capacitor C104. The sensor is factory calibrated to within 5% accuracy by control R106 for the 0 – 2000-watt circuit and by control R107 for the 0 – 200-watt circuit.

The "out-of-phase" (reflected current induced) voltage that was summed with the sampled voltage is rectified by diode D101 and filtered by capacitor C103. With a very good load, one with less than 1.05:1 VSWR, the two voltages will be about equal and out of phase and no reflected voltage will register in the reflected circuits. Reflected power is factory calibrated by control R104 for the 0 – 50-watt scale and by R105 for the 0 – 500-watt scale.

The calibrated voltages from the sensor are routed through a 5-wire shielded cable to switches SW1, SW2, SW3, and SENSITIVITY control R3.

IMPORTANT: The sensor is factory aligned and calibrated, tampering with its components may void the Warranty on your Antenna Tuner.

Switching Circuits

NOTE: The forward and reflected circuits are virtually identical. In the following discussion, we will explain the operation of the forward circuits. Where differences exist between the basic operation of the two circuits, further details will be supplied.

The forward signal from the sensor is coupled through LOW-HIGH switch SW3. If the output of the transmitter is known to be less than 200 watts, switch SW3 should be set to the LOW (in) position. If the power is greater than 200 watts, set switch SW3 to HIGH (out).

Signals from SW3 are routed directly to SET-FWD switch SW1. When SW1 is in the SET (in) position, the forward (FWD) meter is temporarily disconnected from the circuit. The low-current input from the sensor is coupled directly through SW1, through Sensitivity control R3, to the contacts of SWR-REF switch SW2. The SET position of SW1 is used only in conjunction with SW2 when SW2 is in the SWR position. At that time, the REF (reflected) meter "Set" index is used to calibrate the meter for SWR readings.

When switch SW[illegible] is in the FWD [illegible] position, the [illegible] meter is again enabled to measure forward power. When switch SW[illegible] is in the SWR position, it [illegible] shows the amount of standing wave apparent at the [illegible] transmission line. When SW[illegible] is in the REF [illegible] position, the power reflected through the transmission line from the antenna [illegible] is indicated on the RF[illegible] meter in watts.

When switch [illegible] is in the [illegible] position, the [illegible] SW[illegible] not be applied to the FWD and REF meters.

COAXIAL SWITCH (SW101)

The coaxial switch will select any of four outputs to antennas, feed lines, or dummy loads. When this switch is in the bypass position, signals are routed through the sensor and directly out of the Tuner, bypassing the tuner load-matching function.

The other coaxial jacks are used for feed lines to tribanders, center-fed doublet antennas, etc. In addition, the output signal is fed [illegible] J5, on the rear panel, when antenna switch SW101 is in the long-wire position. This allows the signal to be fed to single wire antennas. A [illegible] bar is connected between connectors J3 and J4. Connectors J4 and J5 are used for balanced [illegible] feed line antennas.

All input signals other than those routed to bypass are routed through the meter and [illegible] circuits. Those routed to J7 will also bypass the meter circuits.

LOGGING CHARTS

FREQUENCY	ANTENNA	TRANSMITTER MATCHING	INDUCTOR	ANTENNA MATCHING

Heathkit®

FREQUENCY	ANTENNA	TRANSMITTER MATCHING	INDUCTOR	ANTENNA MATCHING

PRESET CHART

FREQUENCY (IN MHZ)	TRANSMITTER MATCHING	INDUCTOR	ANTENNA MATCHING
1.800	61	378	57
1.900	57	364	54
2.000	54	352	49
3.500	50	148	50
3.750	50	134	49
4.000	50	123	48
7.000	50	58	50
7.150	50	56	50
7.300	50	55	50
14.000	46	25	47
14.100	48	26	44
14.350	45	26	42
21.000	52	16	40
21.200	48	16	38
21.450	43	15	33
28.000	50	18	30
29.000	48	17	28
29.700	47	16	37

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath/Zenith Computers and Electronics centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number
- Model number
- Date of purchase
- Location purchased or invoice number
- Nature of the defect
- Your payment or authorization for COD shipment of parts not covered by warranty

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH/ZENITH COMPUTER AND ELECTRONICS CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath/Zenith Computer and Electronics centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath/Zenith Computer and Electronics center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label
- The date of purchase
- An exact description of the difficulty
- Everything you have done in attempting to correct the problem

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heath/Zenith Computer and Electronics Center facilities are also available for telephone or "walk in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heath/Zenith Computers and Electronics center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address
- Date of purchase and invoice number
- Copies of all correspondence relevant to the service of the kit
- A brief description of the difficulty
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of resilient packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place the carton in another one with 3-4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or Insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022